Review of NSW Distribution Network Service Provider's Measurement and Reporting of Network Reliability

Prepared for IPART by
PB Associates

INDEPENDENT PRICING AND REGULATORY TRIBUNAL
OF NEW SOUTH WALES

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The views expressed her are those of the author alone and do not reflect the position of IPART or the New South Wales Government. The author of this report is PB Associates.

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Reliability Measurement

Review of NSW Distribution Network Service Provider's Measurement and Reporting of Network Reliability

Prepared for

The Independent Pricing And Regulatory Tribunal of NSW

***PB Associates** Quality System:*

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SECTIONS

1. SUMMARY

The Independent Pricing and Regulatory Tribunal of New South Wales (the Tribunal) has commissioned PB Associates to undertake a review of the NSW Distribution Network Service Providers' (DNSPs') measurement and reporting of network reliability.

PB Associates has reviewed the processes, systems and procedures of each of the 4 NSW DNSPs. The review was undertaken via questionnaire, visits to each DNSP and subsequent communications.

The general findings are that the systems and processes employed by each of the businesses are significantly different and reflect the different environments and histories of the businesses. A significant factor in the review was the differences in reliability measurement and reporting within some businesses. This is particularly evident with those businesses that have been formed via the merger of smaller units.

In general, PB Associates found the systems, processes and procedures for the capture and reporting of reliability information to be reasonably robust. PB Associates has identified a number of issues that may lead to data inaccuracy. Although the individual areas of inaccuracy are generally small, the cumulative effect of these items may be considered significant.

Company	Potential Reliability Information Variation[1]
AIEW	-10% to +15%
Country Energy	+15% to +30%
Integral Energy	-5% to +20%
EnergyAustralia	-10% to +10%

Table 1.1

Without exception, each of the DNSPs has projects that are currently being implemented that will result in improvement to the capture and reporting of reliability information. PB Associates has been provided with information detailing the proposed works and this is detailed in the individual company sections of this report. In most cases, the proposed works involve the replication of the physical network (assets) in an electronic model and the linking of customer information to that model.

PB Associates has been provided with cost and budget information to support the proposed information systems described above. In most cases the works to improve reliability data capture and reporting are included as part of a larger system improvement (e.g. a Works management systems or asset management systems).

As the reliability reporting improvement works are contained as intrinsic parts of the total planned system improvements it has not been possible for PB Associates to specifically separate and identify a singular cost for the improvements to reliability reporting.

[1] These figures represent a summary approximation of the potential data and reporting inaccuracies that may result from the accumulation of identified inaccuracies. Further information of the supporting information for each company figure is provided in the individual company sections. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential for actual reliability data to be lower than that presently reported.

The following table provides a summary of the costs of the new proposed systems and the projected timeframes for implementation.

Company	Budget	Time frame
AIEW	Not available[2]	2 year
Country Energy	$7 - $9 Million	3 years
Integral Energy	$X[3] Million	3 years
EnergyAustralia	$5 - $6 Million	3 years

Table 1.2

More specific information on the proposed system improvements is provided in the individual company sections of this report. PB Associates considers that the proportion of costs indicated above that relate directly to reliability measurement and reporting to be relatively small. Additional costs may be required to fully align the reporting from the information systems with SCNNR and IPART requirements.

1.1 CONCLUSIONS

The following is a summary of the significant items raised in the body of the report;

- Each of the DNSPs employs systems to capture, record and report reliability data. These systems vary considerably between each business, while EnergyAustralia and Country Energy reported significant differences in the systems employed across respective regions.
- Based on the above, the potential for error in reporting varied within and between the DNSPs. A potential range of variation is provided in Table 1.1 above. The figures reported represent DNSP-wide accuracy and PB Associates considers that the accuracy variation that may occur at the individual feeder level would be considerably higher.
- PB Associates notes that SAIDI, CAIDI and SAIFI are worldwide standards. The reliability measurement and reporting in/accuracies detailed in this report are considered similar in impact to those of international utilities.
- The report finds that the definition of a customer was reasonably consistent across the NSW DNSPs and was likely to have minimal affect on network reliability calculations.
- The availability of connectivity data (the smallest network segment that customers are generally allocated to) varied between each business and ranged between the feeder circuit breaker and the distribution substation.
- The DNSP's each maintain a history of reliability information. In most cases PB Associates considers that the usefulness and accuracy of this information is limited to a 3-5 year window based on previous Information Technology changes and the merger of businesses.

[2] Cost for AIEW SCADA system and GIS are not available at this time.
[3] Budget figure has been removed from Table as there is a tender process underway and the Integral Energy budget is therefore considered commercially sensitive at this time.

- The capture and reporting of reliability information at the individual customer level is not supported by the current systems and processes employed by the DNSPs.

- In general, the DNSPs would have considerable difficulty in extracting individual customer reliability statistics, particularly where a number of different fault types were involved. Individual customer reliability information is available for some customers (e.g. High Voltage customers) and some types of faults (e.g. feeder faults).

- The determination of likely accuracy ranges for individual customers or individual feeders is not presently feasible. The determination of an accuracy range for individual feeders would require an assessment of the characteristics of that feeder including; the specific feeder configuration, the particular DNSP systems and processes employed, the customer mix and asset mix of the feeder.

- PB Associates considers that the NSW DNSPs are on a "par" with international and national power quality implementation. The NSW DNSPs are up to date and aware of power quality monitoring current trends and are presently reviewing and trialing the new technologies that are available.

- Each of the DNSPs has projects that are currently being implemented that will result in improvement to the capture and reporting of reliability information. PB Associates considers that these projects have the potential to address the majority of reliability reporting inaccuracies identified in this report.

- Due to the developmental nature of the new DNSP information systems relating to reliability reporting, PB Associates considers it important that the definitions and structure of the reporting framework are developed in sufficient detail to allow the DNSPs to incorporate these requirements into the new information systems.

- PB Associates has reviewed a number of reliability measures as potential additions or alternatives to the present framework. PB Associates considers that the measures of "MAIFI" and "Faults per kilometre" are both measures that would provide an enhanced measurement framework and could be supported with minimum alterations to the existing DNSP systems and processes. The use of "Energy not delivered" is not recommended by PB Associates due to the difficulties in implementation.

- Each of the DNSPs record outage incidents in a computer database(s). The format of the databases is different between each DNSP although a common file format is possible (e.g. CSV - Comma Separated Values). PB Associates notes that the cause categories are different between each DNSP and suggests that a common standard would be beneficial to the accumulation of this data. The ESAA cause categories may be utilised to provide a common cause categorisation standard.

1.2 IMPLICATIONS

- **Setting Reliability Targets** – The PB Associates review has highlighted varying degrees of inaccuracy in the capture and reporting of reliability information. Based on this review, PB Associates considers that it is feasible to set reliability targets for the DNSPs at the system wide SAIDI, SAIFI and CAIDI level.

  Historical information should exist to support these targets and provide a degree of certainty to the businesses in terms of annual variations.

The present systems for reliability data collection are however insufficient to support the setting of reliability targets at a lower level. PB Associates considers that it would not be possible to presently set targets for CBD, urban, short rural and long rural feeder performance. Each of the DNSPs is presently evaluating or implementing information systems to address this level of reporting.

A short-term alternative may be for the DNSPs to nominate target performance levels, and/or to provide comparison with the equivalent Victorian target levels.

- **Implementing An S-Factor** – The reliability measurement and reporting improvements that have been identified by the DNSPs are likely to have a direct impact on the accuracy of the reliability figures. PB Associates considers it likely that a general increase in the actual figures (e.g. SAIDI and SAIFI) is possible as the collection and reporting processes are improved.

  Based on this, it is likely that the introduction of an "S-factor" style of reliability incentive could result in a potential negative revenue bias as the reliability measurement systems are improved.

  PB Associates would recommend that an S-factor style scheme be implemented following the introduction of the proposed DNSP information systems in 1-3 years.

- **Using The SCNRRR Framework** - The reliability reporting systems of the NSW DNSPs are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

  PB Associates considers that most of the DNSP systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information is available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information should also be available for both planned and unplanned outages.

  The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

  Historical reliability data is generally not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates considers that it would not be possible to accurately determine this information from the existing systems. A recommended timeframe for implementation of these measures is 1-3 years.

  The present day collection of MAIFI data is mostly incomplete. Based on this, PB Associates considers that the provision of historical MAIFI data would be of limited regulatory value. Implementation of a MAIFI measure is dependent upon the implementation of processes within the DNSPs to manually read remote reclosers. Cost and labour issues aside, the implementation of such a scheme could be undertaken over a one-year period.

- **Compensating Customers** – PB Associates considers that a system for compensating customers for poor reliability or quality of supply is soundly based and generally provides the right incentive signals to customers and DNSPs.

  The compensation of customers on a system wide basis (e.g. for overall SAIDI, SAIFI and CAIDI) is not considered feasible. Such a system would place significant financial risk on a business or provide such a small payment to customers as to be of little value.

The provision of compensation for localised poor reliability or quality of supply is an emerging regulatory tool. However, as discussed above, the present DNSP systems do not support the collection and reporting of reliability information at a localised level. PB Associates would recommend that a customer compensation scheme is developed to advantage customers who are subject to reliability that is outside of accepted standards. Implementation of the scheme should coincide with the DNSP information system improvements detailed in this report.

A compensation scheme for verified quality of supply complaints is feasible and the information to support such a scheme is more readily available from the DNSPs. The implementation of a set of common definitions for both quality of supply complaint and causes would be required to support any compensation scheme. It would also be important to structure the scheme to identify and isolate quality of supply causes that are extrinsic to the DNSP involved. (E.g. TV interference from third parties, waveform distortion from third parties, etc.)

2. INTRODUCTION

The Independent Pricing and Regulatory Tribunal of New South Wales (the Tribunal) has appointed PB Associates to undertake a review of the NSW Distribution Network Service Providers' (DNSPs') measurement and reporting of network reliability.

The objective of this consultancy is to establish the extent to which DNSPs' information management systems and procedures support the accurate and verifiable reporting of network reliability, and the identification of customers affected by unsatisfactory reliability. The consultancy is to also identify any improvements to DNSPs' systems and procedures necessary to support implementation of a service standards and/or incentive regime.

As part of the 2004 Network Price Determination, the Tribunal proposes to define the reliability standards expected to be met by DNSPs over the next regulatory period. The Tribunal will also consider whether to explicitly provide for a quality of service incentive mechanism in the 2004 or a subsequent Determination.

As a related matter, the Tribunal is currently reviewing DNSPs' licence conditions. One aspect of that review will be to consider whether additional minimum service standards are required. Such conditions could require DNSPs to compensate customers affected by interruptions to supply that exceed specified minimum standards.

Network reliability is currently monitored through reports by DNSPs to the Ministry of Energy and Utilities (MEU). The network performance data in these reports is summarised and published by the MEU in annual Electricity Network Performance Reports. DNSPs' performance against licence conditions is reported to the Tribunal, and summarised in the Tribunal's annual licence compliance reports.

There is currently no national or state based centralised fault and interruption reporting system and therefore each DNSP has developed its own systems for the recording of faults and interruptions. Furthermore, as a result of restructuring of the industry, DNSP's may have a number of methodologies for handling fault and interruption data.

Standard definitions of network reliability measures were recently agreed by a jurisdictional Regulators' Steering Committee on National Regulatory Reporting Requirements (SCNRRR). This consultancy is being conducted in the context of DNSPs' capacity to report against reliability measures as defined by SCNRRR, and other measures described in this project brief.

The Tribunal has appointed PB Associates to undertake a review to determine whether DNSPs will be able to provide reliable and accurate reporting against standardised measures of reliability, and any particular issues that may arise in incorporating these measures in pricing determinations and licence conditions.

The Tribunal has advised DNSPs that as part of the 2004 Network Price Determination, average and target standards of service will be set for the following measures of network reliability:

- Total duration of *planned* interruptions per customer per year (SAIDI)
- Total duration of *unplanned* interruptions per customer per year (SAIDI)
- Number of *unplanned* interruptions per customer per year (SAIFI).

Service standards will be set for four categories of feeder – CBD, urban, rural short and rural long. *Average* service standards will apply to the average reliability of feeders within each category. Target service standards will apply to each feeder within each feeder category.

The Tribunal will also consider whether service standards should be set on a similar basis for the number of momentary interruptions (MAIFI), and the volume of energy not supplied due to sustained interruptions to supply.

PB Associates are required to consider the DNSPs' capacity to report against all of the above measures of reliability, and to disaggregate the reporting by the SCNRRR data sets and feeder classifications, where appropriate. PB Associates are also required to consider disaggregation by cause of interruption to supply.

3. TERMS OF REFERENCE

PB Associates is to undertake a Direct Review of the information management systems and processes of the NSW DNSPs in relation to the measurement and reporting of network reliability, and prepare a report outlining the issues and findings. The review is to be conducted in accordance with Australian Auditing Standard AUS 810[4].

PB Associates will conduct site visits to;

- EnergyAustralia (Sydney, Newcastle, Hunter Valley),
- Integral Energy (Huntingwood),
- Country Energy (Port Macquarie, Bathurst, Queanbeyan, Wagga Wagga, Moruya) and
- Australian Inland Energy & Water (Broken Hill)

to examine the DNSPs' information systems and interview any relevant staff.

PB Associates will:

1. Describe the systems and procedures used by each DNSP to measure, record or collect data on interruptions to supply, and translate the data into measures of network reliability.
2. Identify potential sources of error or inaccuracy in the systems and procedures, and processes that are not documented, verifiable or reproducible.
3. Determine the contribution of any potential source of inaccuracy or error in the systems and procedures to inaccuracies in final data, and the overall accuracy of final data.
4. Determine the availability of verifiable historical data to establish trends in network reliability, and the consistency or comparability of historical data with the proposed reliability measures.
5. Investigate DNSPs' capacity to identify customers affected by interruptions to supply. If affected customers cannot be identified individually, the consultant is to investigate whether a group of customers likely to have been affected can be identified, and to what level of accuracy.
6. Investigate DNSPs' capacity to assess the level of voltage fluctuations occurring on various parts of the network.
7. Propose changes to systems and/or processes to enable reliable and accurate reporting against the proposed reliability measures, or improve the accuracy and verifiability of current processes; and outline the required changes to systems and processes to enable identification of customers affected by major supply interruptions.
8. Estimate the likely range of costs of the above changes and improvements in item 7, and a reasonable timeframe for implementation.
9. Where reporting against the proposed reliability measures could result in a high level of inaccurate or non-verifiable data, propose alternative measures or definitions of network reliability that could be reported against in a more robust and verifiable form.

[4] *Special Purpose Reports on the Effectiveness of Control Procedures*

10. Describe the format and the structure in which the reliability data is held by each DNSP, and any issues in translating the data into the proposed SCNRRR framework. Recommend the most efficient method to transfer and re-configure all the DNSP data into an appropriate statistical package for analysis by Tribunal staff.

4. SUMMARY FINDINGS

The information provided in this section represents a summary of the PB Associates review of the four New South Wales Distribution Network Service Providers (DNSPs). The information is general in nature and care has been taken not to provide any information that may be considered sensitive or commercial in nature. PB Associates has been requested to remove one item relating to a cost that my affect the outcome of a tender process. PB Associates does not consider that the removal of this single item has in any way reduced the accuracy or applicability of this report.

More detailed and specific information is provided in the individual company sections of this report.

4.1 SYSTEMS AND PROCEDURES

Describe the systems and procedures used by each DNSP to measure, record or collect data on interruptions to supply, and translate the data into measures of network reliability.

The principle finding of the PB Associates review of the DNSP systems and procedures is the diversity of these systems and processes both between the DNSPs and within each business.

The individual systems and processes of each DNSP are addressed separately, however it is important to highlight that there was significant differences between each of the DNSPs in terms of each of the review parameters.

Measurement

The measurement of reliability information by each of the DNSPs was perhaps the most similar of each of the system and processes.

The capture of reliability statistics is essentially a process of linking an network outage incident to the customers interrupted by the incident. As an incident (e.g. resulting from a short circuit fault) may occur on any part of the network, it is necessary to create a link that is representative of the connectivity of the network in terms of fault location, associated network outage, and customers interrupted (affected) due to the network outage.

If we consider a DNSP electrical network as a linear system, a simplified structure would be as follows;

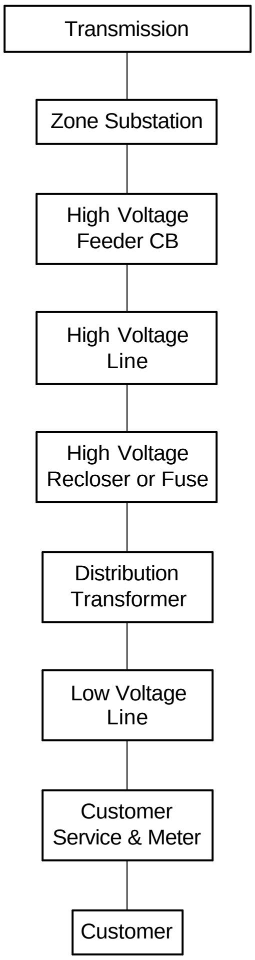

Figure 4.1

As most customers are supplied via the end of this chain, the greatest accuracy from a reliability measurement system will be gained from a system that links the customer at the lowest possible level. In general, the DNSPs reviewed had customer/asset links at the Distribution Transformer level or higher. This means that the collection of data below this level must come from approximations and manual intervention.

In general, the greater the degree of approximation and manual intervention, the more inaccurate the information. In most cases the capture of reliability information did not occur for single customer outages (i.e. those occurring on the customer service or meter).

As mentioned above, the linking of customers with assets was done at the High Voltage asset level – typically via an allocation of a customer to a distribution substation. The quality and completeness of the customer-to-substation allocation was not 100% with some of the businesses reporting a large percentage of customers that were not allocated to substations.

It is also important to note that in the present systems used by the DNSPs, there is insufficient linkage within IT systems between assets further up the chain to automate the calculation of customer numbers affected where network outages affect network assets higher up the chain. For example: if customers are linked only to distribution substations, but distribution substations are not linked to HV feeders, then customers numbers affected cannot be automatically calculated for an HV feeder outage. This generally requires some manual cross reference to account for this linkage. For example: in the case of the HV feeder outage, an operator could cross reference a schematic of a the HV feeder to find the distribution substations affected, these distribution substations can then be interrogated in the IT system to get the total customer numbers affected. All DNSPs presently require some level of manual cross referencing between IT systems and/or paper systems.

Recording & Collecting

Without exception each business had multiple mechanisms for the recording and collection of reliability information. This is a reasonable approach due to the degree of automation and remote communications typical within Australian utilities. A representative break-down of the recording and collection systems would be as follows;

- Planned outages
- Unplanned Transmission, sub-transmission and HV feeder (SCADA capture)
- Unplanned High Voltage and multiple-customer Low Voltage (non-SCADA capture)
- Single customer low voltage

The information supplied to PB Associates would indicate that the recording of planned outage information is the most robust of the processes reviewed. The recording of planned customer outages was generally well documented. Small inconsistencies may exist with the collection of information from smaller regions and areas.

At higher voltages (e.g. 132kV and 33kV), most of the companies had well-developed communications systems (SCADA) that provided (near) real time information on the state of the network. This included High Voltage feeder information where the fault isolation occurs at the zone substation feeder circuit breaker. Only a relatively small number of remote communications schemes were reported for asset below the High Voltage Feeder circuit breaker.

Outages and interruptions at this level were generally very well recorded, although the systems for translating the SCADA information into the general outage recording systems were typically manual.

For outages that occur "downstream" of the zone substation circuit breakers, most companies relied on a number of different processes to capture the information. Outages that involved numbers of customers were typically treated differently from single customers outages. In most instances, single customer outages were not captured in reliability measurement information systems.

A common theme amongst the DNSPs in the collection of data relating to this class of outages was the requirement to estimate customer numbers. A number of mechanisms were employed to estimate the customers affected by an unplanned outage. The mechanisms employed were different for each DNSP and often different within each business as well. The degree of accuracy of the estimation systems reviewed was not overly high. Specific accuracy assessments are provided in the individual company sections of this report.

Translating & Reporting

The PB Associates review did not highlight any major errors or inconsistencies in the processes utilised by the businesses to translate and report reliability information.

One instance of a material error in a documented process was discovered. The particular error may have contributed to a reduced figure for power quality complaints.

The major concerns to PB Associates in this area were;

- The translation and reporting processes involved a high degree of manual intervention to amalgamate the required information.

- Spreadsheets and custom-databases that were not quality assured or verified.
- Lack of audit history on the reliability processes and systems.
- Lack of quality controlled procedures for reliability data capture and reporting.

In PB Associates' opinion, the items identified above are related and may contribute to compound errors in reporting.

4.2 POTENTIAL SOURCES OF ERROR AND INACCURACY

Identify potential sources of error or inaccuracy in the systems and procedures, and processes that are not documented, verifiable or reproducible.

PB Associates identified a number of areas that represent actual and/or potential sources of error or inaccuracy in the collection of reliability information. The range of error sources was particularly diverse ranging from manual typing errors to significant gaps in customer information.

The major items are identified below. Individual company sections identify those items that relate specifically to each Distribution Business.

- Customer number estimation – All companies reported the use of some level of estimation for establishing the numbers of customers affected by certain system faults. The type and process for estimation was different across each Distribution Business. Examples of estimates are as follows;
    - Estimation of customer numbers based on postcode ratios. The use of postcode customer data to allocate average customers numbers across Low Voltage circuits and hence substations and High Voltage feeders.
    - Estimation of customer numbers based on LV circuit. The use of total substation customer numbers to allocate based on a Low Voltage circuit interruption. In this event the total customer numbers attributed to the substation are split evenly between the number of reported Low Voltage circuits.
    - Estimation of customer number based on phasing. The use of High Voltage and Low Voltage allocations for single-phase High Voltage and Low Voltage faults. In the event of a single-phase High Voltage fault the number of customers assumed affected is 2/3, and for a low voltage single-phase fault the number of customers affected is assumed to be 1/3.
    - Estimation of customer numbers based upon other network properties such as interrupted connected KVA of distribution transformer rating or interrupted kVA of load.
- Customers not allocated to asset/reporting system – As mentioned in section 4.1, the linking of customers to assets is an essential facet in the collection of reliability information. The PB Associates review highlighted a number of deficits in the completeness of the customer information as it related to system assets.
- Manual processes – The use of manual inputs and manual transfer of data provides for a risk of "human error" data entry. Most systems reviewed by PB Associates did not have the mechanism to cross-check or validate data that was entered manually. While PB Associates considers it likely that manifest errors will be identified through the review of reliability reports, smaller and/or regular errors in data entry would most likely not be discovered.
- Audit checks and cross-checking mechanisms – Related to the issue of manual processes (above). The majority of systems reviewed by PB Associates did not

involve a process for the cross-checking or validation of the original data. PB Associates sighted documentation from one company of an audit relating to the collection and reporting of reliability information. Two other companies provided documentation of the independent Appraisal associated with License Compliance reporting.

- Inactive and unmetered customers in base customers – The inclusion of inactive and unmetered supply points in reliability statistics is a potential source for errors in data comparison. PB Associates noted a number of inconsistencies in the companies reviewed with respect to the treatment of this information and the standards described in the SCNRRR documentation.

- LV single premises outages not captured – Outages that effect single customers are typically not captured by the DNSPs as contributing to reliability statistics.

Excluded Events

It is typical for companies not to report those events that are beyond the control or influence of the business. Such events may included damage by third parties, transmission and embedded generation failures, force majeure events and unsafe customer installations. At present the SCNRRR guidelines focus on major natural events for exclusion.

All electrical networks (overhead and underground) are affected by severe weather, and other natural and third party events. Networks are designed to withstand certain extremes of weather. However, unusually severe weather events do occur and can have deleterious effects on the reliability of electrical systems.

Most electrical companies around the world recognise that sever weather is unpredictable and have developed systems to separately identify the impacts of severe weather in annual reliability reports.

In the US, storm classifications are often referred to as "Major Event Days". A typical definition for a Major Event Day is as follows;

"Designates a catastrophic event which exceeds reasonable design or operational limits of the electric power system and during which at least 10% of the customers within an operating area experience a sustained interruption during a 24-hour period."[5]

A number of issues have been identified with the use and misuse of the above definition. Both EnergyAustralia and Country Energy identified to PB Associates concerns with the definition of an excluded event, mainly in terms of the 3 minute SAIDI impact.

Work is presently underway in the US by the IEEE Working Group on System Design to determine a definition of a "Storm" or "Major Event Day". At present four methods are being reviewed for their applicability to utilities. The alternatives presently being considered[6] are;

- The traditional IEEE definition, which identifies a major event as one that impacts at least 10% of a company's customers in an operating area during a 24-hour period. (Examples: ComEd and the PECO system.)

- The bootstrap method, which defines major event days as those whose SAIDI per day, is greater than the worst days per year when comparing to prior years. The identification of SAIDI per day threshold values based on 3-year and 5-year histories.

[5] From IEEE Std 1366-1998

[6] A Comparable Method for Benchmarking the Reliability Performance of Electric Utilities. D. A. Kowalewski,– August 2002.

- The three-beta method uses five years of SAIDI (per day) data (or as many as the utility may have up to five). In this method, the natural logarithms of SAIDI per day are calculated to convert to a log normal distribution. The threshold for identification of major event days is then computed using three standard deviations above the mean. The identification of SAIDI per day threshold values again based on 3-year and 5-year histories.

- The 6-beta method uses five years of SAIDI per day data (or as many as the utility may have up to five). This method was considered as a way to identify events that are so large that they would completely dominate any multi-year reliability calculations of which they are a part.

- Variations of these and other techniques

PB Associates understands that the three-beta method is presently the preferred alternative by the IEEE. This method removes the inaccuracies and biases of the traditional IEEE approach (10% of customers). PB Associates also considers this approach to be superior to the multiple storm definitions that are presently utilised across NSW and Australia, however, changes to existing reporting requirements would need to be reviewed by and agreed to by SCNRRR before being implemented.

4.3 CONTRIBUTIONS TO ERROR OR INACCURACY

Determine the contribution of any potential source of inaccuracy or error in the systems and procedures to inaccuracies in final data, and the overall accuracy of final data.

The DNSPs have identified and provided information relating to a number of potential sources of inaccuracy relating to the reliability measurement. Section 4.2 details the major sources of potential inaccuracies. More detailed information on potential sources and the contributions to error of those sources are detailed in the individual company sections of this report.

The following table (table 4.3) is a summary of the overall data variation that PB Associates estimates as being due to the identified sources of data inaccuracy.

Company	Data Variation
AIEW	-10% to +15%
Country Energy	+15% to +30%
Integral Energy	-5% to +20%
EnergyAustralia	-10% to +10%

Table 4.3

A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential for over reporting. As an example; For Integral Energy, the above chart is suggesting that the presently reported reliability data is 5% and 20% less than the likely actual figures.

The summary table does not represent a simple accumulation of the individual variation sources. PB Associates deems that a simple summation of the variation sources would not be representative of the actual overall position of each company due to the interrelated nature of the various sources.

The accuracy data provided above predominantly applies to SAIDI and SAIFI calculations. PB Associates considers that the impact upon CAIDI calculations will be minimal and that the inaccuracies identified in this report will most heavily impact the SAIDI and SAIFI measures. The accuracy impacts on the SAIFI and SAIDI figures will be reasonably similar given the mathematical relationship between the three abovementioned measures.

The above accuracy ranges apply to the company-wide reliability data. PB Associates notes that the potential for accuracy variation at the individual customer or feeder level is significantly greater than that identified above. The determination of accuracy ranges for reliability data at the feeder level is extremely difficult to determine as the accuracy would be dependent upon the specific feeder configuration, region, customer mix and asset mix.

It is worthy to note that, on average, the overall variation ranges are weighted towards the positive. Based the measurement improvements detailed in sections 4.7 and 4.8, it is likely that future reliability reporting figures will be more accurate than those of the present. Under the scenario that the physical reliability of the network remains constant PB Associates would expect to see a potential worsening of overall reliability statistics.

PB Associates considers that international and local trends in electrical network reliability have been consistently positive (i.e. improving) in recent years and we would expect this trend to somewhat mitigate the reductions due to improved reporting techniques.

4.4 HISTORICAL INFORMATION

Determine the availability of verifiable historical data to establish trends in network reliability, and the consistency or comparability of historical data with the proposed reliability measures.

Significant effort has been undertaken in NSW over the last decade to reduce the number of electricity businesses. The industry has moved from a large number of operators (typically local councils) to the larger undertakings that we are familiar with today.

Incumbent in this process has been the requirement to merge operating systems and processes as each entity is joined. In most cases the businesses that are being merged operated differing processes and systems. To attain the synergies of merged operations it is most often necessary to either;

i) merge the individual systems and processes or

ii) replace both systems and processes.

PB Associates notes that the merging of these systems and processes remains an ongoing challenge. The recent merger of Advance Energy, Great Southern Energy and NorthPower to form Country Energy has identified a large number of process integrations and replacements.

Both of the above options represent a discontinuity with respect to reliability reporting. As detailed in the individual sections of this report, most of the companies reviewed have identified discontinuities in reliability information that relate to the merger or integration of previously separate entities.

The accuracy of historical data is also subject to the issues identified in section 4.3. PB Associates has sighted documentation and information highlighting the improvements that have been made to reliability measurement over the last 5 years. Although these improvements are basically incremental, the overall effect is to limit the accuracy, and therefore value, of historical reliability information.

In summary, the availability of historical data is limited to 3-5 years due to the above and the accuracy of that information significantly reduces in the 3-5 year range.

4.5 CUSTOMER IDENTIFICATION

Investigate DNSPs' capacity to identify customers affected by interruptions to supply. If affected customers cannot be identified individually, the consultant is to investigate *whether a group of customers likely to have been affected can be identified, and to what level of accuracy.*

Customer identification is an area that each of the DNSP's has identified for future improvement.

As mentioned previously (section 4.2), the association of customers with assets is critical in the identification of customers and customer numbers affected by supply interruptions. At present the DNSP's have reasonably accurate information of customer numbers at the higher voltage asset level. Customer number information at the low voltage level is not as complete.

Although small in number, faults that occur on the sub-transmission and high voltage systems have the greatest impact on overall SAIDI, SAIFI and CAIDI figures. On the other hand, low voltage and customer premises faults represent the greatest number of reported faults, but contribute only a small proportion of the SAIDI, SAIFI and CAIDI figures.

Based on the above, the combination of reasonably accurate high voltage asset/customer allocations will produce reliability information that is overall reasonably accurate.

The identification and reporting of low voltage supply interruptions is not as accurate or complete as that for high voltage, although the impact on overall SAIDI, SAIFI and CAIDI is not very high.

As described in section 4.2, all companies reported the use of some level of estimation for establishing the numbers of customers affected by certain system faults. The types and means of estimation varied between and within companies and included;

- Estimation of customer numbers based on postcode ratios.
- Estimation of customer numbers based on LV circuit.
- Estimation of customer number based on HV and LV phasing.
- Estimation of customer numbers based upon interrupted kVA of load or connected distribution transformer capacity.

The use of estimation creates an inherent potential for inaccuracy. This is particularly the case where an estimation technique does not recognise the potential for bias.

As an example;

> The use of LV circuit customer number estimations assumes that each LV circuit is has an equal number of customers and is likely to be affected by a supply interruption.
>
> However, not all LV circuits are equal.
>
> The nature of distribution systems is that they are typically created and extended in line with customer growth and demand. Changing customer demographics over the last 50 years have resulted in circuits that are lightly loaded and those that are very heavily loaded.
>
> Two primary contributors to electrical interruptions are asset failures and system overloading. In general, circuits with greater numbers of assets and high electrical loads are more likely to fail or suffer from supply interruptions.
>
> PB Associates considers that this is a potential bias in the use of LV circuit estimations and may present results that are more favourable than the actual.

Finally, at least one company has identified to PB Associates a considerable difference between the total number of customers contained in the Customer Information Systems and those utilised for determining customer numbers affected.

In terms of reliability calculations the difference between customers identified against assets for reliability reporting (the numerator) and the total customer numbers (the denominator) was significant and was determined to contribute to a sizeable favourable bias[7] in the reporting of affected customers and SAIDI, SAIFI and CAIDI figures.

4.6 VOLTAGE FLUCTUATIONS & POWER QUALITY

Investigate DNSPs' capacity to assess the level of voltage fluctuations and Power Quality occurring on various parts of the network.

None of the four distributors have the monitoring facilities to assess voltage fluctuations and power quality on the entirety of their network.

Generally, the SCADA systems monitor the majority of their networks down to the out going HV feeder circuit breakers at zone substations.

To improve monitoring of voltage fluctuations on rural feeders, "sentry" devices are used on some feeders, normally for known problem feeders. These are by no means extensive, and the power quality on the extremities of most rural spurs will not be known.

PB Associates would not consider it feasible for a distributor to monitor customer power quality across a network, and unlike loss of supply, most customer are not in a position to accurately know when power quality it outside defined levels. For this reason the true measure of unsatisfactory network power quality cannot be reasonably ascertained.

All distributors do have groups responsible for investigating and resolving power quality complaints by customers, or power quality issues that are discovered during the planning and operation of the network. The distributors do have systems to record customer complaints on power quality issues.

4.7 SYSTEM CHANGES FOR IMPROVED REPORTING

Propose changes to systems and/or processes to enable reliable and accurate reporting against the proposed reliability measures, or improve the accuracy and verifiability of current processes; and outline the required changes to systems and processes to enable identification of customers affected by major supply interruptions.

All distributors, with the exception of AIEW, are proposing to commission a Distribution Management System (DMS), which will lnk all their information systems together – customer information system (CIS), graphical information system (GIS), SCADA, asset management (AM) system, and outage management (OM) system.

This DMS should automate the recording of exact and current customer numbers affected and actual restoration times for HV faults. Much of the existing manual effort with respect to these tasks should be removed.

The DMS should also provide a means of automatically associating individual customers who were affected by specific incidents. It should be noted that in order to do this, all customers would have to be linked to a network asset, normally a distribution substation. The process of linking all customers to an asset is time consuming, and a number of distributors are presently undergoing projects to achieve this.

It is important to note that all DNSPs have a number of smaller projects underway to improve reliability monitoring and reporting. These projects are discussed in the sections related to the individual DNSPs.

[7] I.e. a bias to reduce the reporting impact of outages over the actual figures.

At present AIEW systems are significantly manual. The next level of reliability measurement improvement will come from the proposed implementation of a SCADA system, GIS and new CIS.

4.8 COSTS FOR IMPROVED REPORTING

Estimate the likely range of costs of the above changes and improvements in section 4.7, and a reasonable timeframe for implementation.

The following table summarises the costs for the system changes discussed in the preceding section. The distributors have provided these costs.

It is clear that not all the DMS and associated costs are directly related to reliability monitoring and reporting, however, PB Associates has insufficient information to further breakdown overall budgets into reliability improvement allocations.

Current Reliability Measurement Improvement plans and budgets are estimated at:

Company	Budget	Time frame
AIEW	Not available[8]	2 year
Country Energy[9]	$7 - $9 Million	3 years
Integral Energy	$X[10] Million	3 years
EnergyAustralia	$5 - $6 Million	3 years

PB Associates notes that the introduction of the systems identified above may result in reduced manual handling of reliability related information.

4.9 HISTORICAL DATA

The reliability reporting systems of the NSW DNSPs are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

PB Associates considers that most of the DNSP systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information is available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information should also be available for both planned and unplanned outages.

The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

Historical reliability data is generally not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates consider that it would not be possible to accurately determine this information from the existing systems. A recommended timeframe for implementation of these measures is 1-3 years.

[8] Cost for AIEW SCADA system and GIS are not available at this time.
[9] This cost relates to the VOSC/DMS project of which not all of the estimated $7-$9 million relates directly to reliability monitoring and capture.
[10] Budget figure has been removed from Table as there is a tender process underway and the Integral Energy budget is therefore considered commercially sensitive at this time.

The present day collection of MAIFI data is mostly incomplete. Based on this, PB Associates considers that the provision of historical MAIFI data would be of limited regulatory value. A recommended timeframe for implementation of the MAIFI measure is 1-3 years.

Changes in the reliability measurement/reporting systems and the proposed changes in the definitions of the reliability measures, to align with the SCNRRR standards, will mean that historical data that has been collected and reported in the past will not necessary align with data that will be collected and reported in the future. There will also be a period of transition over the next 3 years before systems have been fully implemented and provide the necessary sound and robust base of data.

4.10 ALTERNATIVE RELIABILITY MEASURES

The traditional methods of reliability reporting in Australia are predominantly based on SAIDI, CAIDI and SAIFI. These measures have been widely used across the Australian industry and a significant amount of historical information is available relating to these measures.

As has been previously noted in this report, the reliability, accuracy, consistency and history of the SAIDI, SAIFI, and CAIDI figures are less than desirable for regulatory reporting purposes.

4.10.1 Energy Not Delivered

PB Associates has experience from many countries around the world in electricity measurement. SAIDI, SAIFI and CAIDI are utilised by many countries including the United Kingdom and Unites States.

Another measure of reliability that is commonly utilised in Asia (e.g. Singapore) is that of energy not delivered. Energy not delivered is typically defined as the value of energy (kWh or MWh) that was not transferred due to interruptions to the supply system.

In practice, energy not delivered is an estimate of the load that is lost (dropped) when a fault occurs multiplied by the length of the supply interruption.

From a theoretical perspective energy not delivered is preferable as a measure of network performance as it indirectly recognises the scale of customer interrupted. In other words, one of the failings of the SAIDI, SAIFI and CAIDI measures is that they do not recognise any difference between a large electricity customer and a small customer.

The following two examples provide a review of some of the limitations of the SAIDI, SAIFI and CAIDI measures in comparison to an "energy not delivered" type calculation. Please note that the energy and electrical usage figures provided are indicative only, although they are plausible.

Example 1

Consider a scenario of an electrical outage to a 500-bed hospital in comparison to a small office. Most people would consider that the outage to the hospital would represent a much higher priority than that of the outage to the small office.

- A one-hour outage to a hospital with 500 beds would result in approximately 2,000 kW of energy not being delivered, a total of 2,000 kWhs of undelivered energy.

- A one hour outage to a small office would result in approximately 5 kW of energy not being delivered; a total of 5 kWhs of undelivered energy.

A SAIDI calculation for the above scenarios would recognise each outage of equal value (i.e. a one hour duration). Whereas an "energy not delivered" calculation would recognise the scale difference between the two outages.

Example 2

Consider a scenario where a hotel with 200 long-term accommodation apartments (or nursing home apartments) is occupied with a similar number of people as 200 privately owned apartments.

- A one-hour outage to the hotel with 200 apartments would result in approximately 3,000 kW of energy not being delivered, a total of 3,000 kWhs of undelivered energy.

- A one-hour outage to the apartment block with 200 apartments would result in approximately 3,000 kW of energy not being delivered, a total of 3,000 kWhs of undelivered energy.

A SAIDI calculation for the hotel would register as a one-hour outage whereas a SAIDI calculation for the apartment block would register as 200 one-hour outages. Under this scenario the number of people affected by the outages are roughly similar, however the SAIDI results are completely different.

An "energy not delivered" calculation of this scenario would provide the values of 3,000 kWhs for both events.

The information provided in the above section has reviewed the concerns with the present SAIDI, SAIFI and CAIDI measures. The information provided in the individual company reports has highlighted the difficulties and inaccuracies implicit in the collection and reporting of the SAIDI, SAIFI and CAIDI information. However, this assessment would not be complete without revi ewing the concerns with the potential use of "energy not delivered" as a reliability measure.

Concerns with the implementation and use of "energy not delivered" as a reliability measure;

- The calculation of the energy not delivered is by its very nature an estimate. It is physically not possible to precisely determine the energy that was not consumed.

- Various means exist to estimate the units of energy not delivered. Each of the estimation options present difficulties in terms of data availability and consistency. The estimation options include the use of;

    - load at interruption commencement

    - load at supply restoration

    - an average of the load at interruption and restoration.

    - standard units based on the types of customers interrupted (e.g. 3kW per hour for a residential customer)

    - historical usage data for the same period (previous day, week, month or year)

- Measurement units of MWh or MVAh can be utilised and are not directly comparable.

- No history of "energy not delivered" exists within the NSW Distribution Businesses on in Australia for comparison purposes.

- The use of energy not delivered requires utilisation data at a level that is not available at present to the NSW Distribution Businesses. Based on the information collected from the NSW Distribution Businesses, PB Associates estimates that the expenditure required to enable accurate measurement of energy not delivered would be significant. Time for implementation would also be considerable.

- Energy not delivered, although utilised in some countries, is by no means an international standard. International comparisons would be very limited and subject to discrepancies depending on the estimation process employed.

Based on the above, PB Associates would not recommend the implementation of "energy not delivered" as a standard measure for reporting purposes. In balance, PB Associates believes that the advantages of the "energy not delivered" measure would be outweighed by the costs, timeframes and potential inaccuracies of the measure.

4.10.2 Faults per Kilometre

The identification of faults on a feeder-by-feeder basis is reasonably advanced across the NSW industry. In addition, the NSW Distribution Businesses also have quite accurate information on the length of individual feeders. These two pieces of information are the basic building blocks of a "faults per kilometre" reliability measure.

The "faults per kilometre" measure is a very useful tool for monitoring the performance over time of an electricity business. The information on each feeder can be tracked allowing the Distribution Business to quickly highlight "rogue" feeders and address systemic problems.

The primary concern with a "faults per kilometre" measure is that it is highly ineffective when it comes to comparisons between businesses.

Each Distribution Business operates in a different and diverse geographic area. EnergyAustralia serves a high-density customer base in comparison to the customer base of AIEW. If we accept that the boundaries of the Distribution Businesses are relatively fixed and that each company is obliged to supply customers within its franchise boundaries we find that each Distribution Business has a ratio of "customers per line kilometre" that is virtually static and unchanging.

The number of customers per kilometre of line is highly correlated to the number of electrical assets per kilometre of line. For example, each customer requires a transformer in close proximity (usually less than 300m). Each customer generally requires a service line or service cable, line connection, disconnection switch or point, meter and fuse or circuit breaker.

Based on the above, the number of electrical assets per kilometre can be seen as closely related to the customer density of the franchise area and that this is a factor that is mostly beyond the control of the Distribution Business.

It is logical that the failures of, or damage to, an electrical asset will often result in an electrical fault and the loss of supply. Therefore, it is logical to assume that a higher concentration of assets per kilometre will result in a greater number of average faults per kilometre - all other things being equal.

The reason for highlighting the relationship between customer density and assets per kilometre is to emphasize that the number of "faults per kilometre" is a measure that is highly related to the density of the customer base. Customer density is a factor that is beyond the control of the Distribution Business and also highly specific to that business.

The above highlights that a comparison of "faults per kilometre" between different businesses would only be as useful as a comparison of the "customers per square kilometre".

This is not to imply that Distribution Businesses are unable to affect the number of faults that occur on their networks. The more correct interpretation would be say that equally competent business, with equal funding and managing their networks in an effective an efficient manner, would have different ratios of "faults per kilometre" that could be attributed to their basic customer density.

Other factors that inhibit the value of "faults per kilometre" as a useful inter-company measure include the respective terrain, accessibility, weather patterns, vegetation, overhead and underground systems, etc.

Based on the above, the "faults per kilometre" measure would be very powerful in monitoring the performance over time of individual Distribution Businesses and very poor in comparing performance between businesses.

PB Associates considers that the feeder segmentation adopted by SCNRRR would ameliorate the company differences when using "faults per kilometre" for comparison purposes. However, we believe that intrinsic differences would still exist that would potentially bias an inter-company comparison based on "faults per kilometre".

Information provided by the NSW Distribution Businesses would appear to indicate that the collection of "faults per kilometre" data could be accomplished by most businesses. The reporting would be highly manual in some cases and would only be possible at the high-voltage feeder level.

Based on the above, PB Associates considers that the use of the "faults per kilometre" measure for regulatory purposes would be appropriate and that the data is generally available.

4.11 FORMAT AND STRUCTURE OF RELIABILITY DATA

Describe the format and the structure in which the reliability data is held by each DNSP, and any issues in translating the data into the proposed SCNRRR framework. Recommend the most efficient method to transfer and re-configure all the DNSP data into an appropriate statistical package for analysis by Tribunal staff.

- *Recommend a standard for capture of "cause" data. (high level only)*

All the DNSPs record the outage incident in a computer database. The database engine and record structure is non-standard between distributors. All databases capture information for each incident. These records hold information such as outage cause, equipment effected, customers affected (or proxies to – e.g. load kVA), restoration times.

It should be possible, with varying degrees of effort on the Distributors part, for each distributor to provide a CVS type text file for a specific period (e.g. 1 year). Each line would relate to each incident record during this period of which fields such as planned/unplanned, time/date, cause, voltage level, equipment affected, weather, customer category (urban/short rural/etc.), HV feeder tag, total customers affected, total customer minutes would be logged. An additional CVS file should also be supplied formatted such that each line contains information such as the HV feeder name, HV feeder tag, total customer numbers for all HV feeders.

The CVS text file is both simple for all Distributor databases to export to and able to be imported into most applications that the Tribunal staff may wish to use to analysis data. The obvious analysis package would be a database, such as Access to store data from each Distributor, and a spreadsheet package to analysis and chart results.

In order to standardise the file to be produced by Distributors, the cause and equipment effected field would have to be determined. Presently, these are different in some of the Distributor databases. The obvious choice for the cause database would be the ESAA cause categories that are already adopted by a number of the Distributors. These categories are as follows:

Cause Description
Equip - Failure or Defect
Loss of Cross border supply
Equip - Inadequate Design/Overload
Loss of Transmission supply
Equip - Inadequate Maintenance
Lightning or Electrical Storms
Major Lightning or Electrical Storm
Wind (Wind debris)
Flood or Cyclone
Snow, Sleet or Blizzard
Trees blown onto Mains
No cause found (storm)
No cause Found
Trees Growing into Mains
Animals and Birds
Corrosion
Pollution
Fire - excluding Pole Top
Vandalism
Accidental (Vehicle, Plant, etc)
Customer Installation
Operator or Staff Error
Industrial Relations
Safety Reasons
Overload
Due to Gen & Trans System
Load Shedding
No cause found (No Storm)
Other

Cause Description
Planned Outages
Planned Outages - Customer Request

5. INTEGRAL ENERGY

5.1 OVERVIEW

PB Associates representatives visited the head office of Integral Energy in Huntingwood over a three-day period to review the reliability reporting processes. As is detailed in this report, Integral Energy have centralised most components of the reliability reporting process in the Huntingwood offices.

Upon arrival at Integral Energy, PB Associates was provided with a completed copy of the Integral Energy questionnaire. The PB Associates staff reviewed the questionnaire and initial questions were directed to the Integral Energy appointed representative.

Subsequent to the questionnaire review, PB Associates staff undertook interviews with the primary participants in the reliability reporting process.

PB Associates notes the effort that had been directed at completing the questionnaire in the short time frame provided and the open access that was provided to Integral Energy staff and documentation.

Information Systems

The current Integral Energy systems for capturing and reporting reliability information are as follows;

- CSS – More commonly known as a "Customer Information System"
- PAD – Power Asset Database
- ESR – Emergency Services Reporting system
- SFR – System Fault Reporting database

A basic outline of the integration of these systems is described in figure 5.1 below;

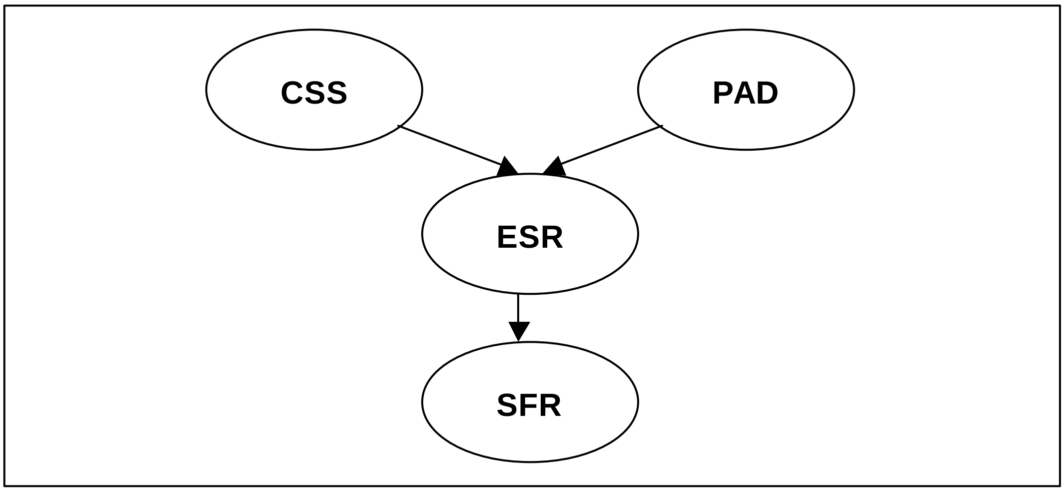

Figure 5.1

The links between systems indicated above are illustrative and more complex in reality. In addition, many of the links between systems are via manual processes and are not automated at the present time.

It is important to note that the primary link between the CSS and PAD information systems is the Distribution Substation identification number contained in ESR. Integral

Energy has allocated the majority of its customer base to each transformer number. This means that customer numbers for faults below this point are required to be approximated. This is discussed in more detail in section 5.3.2.

Future Information System Works

Integral Energy is presently undertaking a project called the Integrated Asset Information Management Strategy (IAIMS). This project is responsible for the creation of a new Distribution Management System (DMS), Outage Management System (OMS), Asset/Works Management System and a Geographical Information System (GIS).

Of equal importance is that IAIMS is also responsible for the integration of the abovementioned systems as well as integration with the existing SCADA and CSS systems. Connectivity will be provided through the Enterprise Application Integration system (EAI also referred to as middleware).

The sub-projects of IAIMS are at varying stages of progress. The Asset/Works Management system is presently planned for completion in March 2003. Phase II of the GIS project is also planned for completion in March 2003.

The Distribution Management System and Outage Management System projects are presently in the early stages of assessment. It is anticipated that an Expression of Interest and Business Case will be complete by the end of 2002. The Request for Proposal is planned for early 2003.

The information provided to PB Associates regarding the IAIMS project indicates that, when complete, this project will greatly enhance the quality and accuracy of reliability information.

The IAIMS project in general and the Outage Management System in particular will provide Integral Energy with the following reliability related modifications;

- Improved identification of customer numbers affected by faults,
- Improved linkages between customers and assets (at a lower level than the present Distribution Substation),
- Reduced manual intervention in reporting process,
- Improved reporting options,
- Improved tracking of faults,
- Improved identification of fault commencement and completion times,
- Simplified allocation of assets and faults to current SCNRRR definitions.

Integral Energy reports that the IAIMS project has been identified in the 10-year Strategic Asset Management Plan 2002-2012[11]. The total cost of the IAIMS project is approximately $25 Million and a portion of this expenditure is allocated to the DMS/OMS

The DMS/OMS project is currently only in the evaluation stage and has yet to be formally accepted by the organisation for implementation. As such, the business rules for reliability reporting are not yet set. It is not presently envisaged that the OMS will capture information relating to low voltage service outages.

PB Associates notes that the clear establishment of reliability data capture definitions and mechanisms during the project definition and scoping stages will greatly reduce the total costs of reliability data capture.

[11] PB Associates Document Reference: IE158099A #12

5.2 POLICIES, SYSTEMS, PROCEDURES AND AUDIT

5.2.1 Network Reliability Reporting

IT Systems

The primary Integral Energy system for reliability reporting is the System Fault Recording database (SFR). The input and control of data being entered into the SFR is described in Integral Energy quality document WPB1007. A copy of this document was supplied to PB Associates.

SFR was created in the mid 1980's. The system is written in a code that is presently not supported by the Integral Energy IT contractor. As a consequence, Integral Energy has determined to replace the reporting engine of SFR with a data query tool that is presently being written in "Cognos Impromptu".

The Cognos Impromptu reporting tool represents a short-term solution, as it is likely to be replaced with the introduction of a Distribution Management System (DMS). Target date for the DMS Outage Management system is presently March 2004.

Data for input to the SFR database is principally sourced from the Emergency Service Reporting (ESR) system and the Integral Energy SCADA system.

The input of data into the SFR database is a highly manual and is well documented in the WPB1007 quality document. PB Associates did not view any instances of manifest errors in the data translation process. However, we believe that the high degree of manual input combined with the lack of any specific audit or error-checking relating to the SFR database is of concern. No estimation of accuracy is possible.

Human Input

The human involvement in reliability data collection and reporting is relatively high for both planned and unplanned outages.

For unplanned outages, fault calls are received through the Integral Energy Call Centre or directly via the SCADA system (for High Voltage feeder faults and above). The fault is then registered into the ESR system. A system dispatcher then assigns the call to an operator or EMSO (Emergency Services Officer) who is then responsible for initial attendance and assessment.

If asset replacement or repair is required to rectify a fault the Operator or EMSO refers the call to the local depot. If no replacements or repairs are required, the operator or EMSO undertakes inspection and restoration, and the information relayed back to the system operations.

The system operators enter information on the incident on a "System Operations Report" form. A data entry officer enters system operations reports into the SFR.

The general level of training/qualifications for those involved in the fault reporting process is described below;

Operators – Trade qualifications, operations skills, in house training and TAFE qualifications.

Dispatchers – Trade qualifications, operating skills, in house training

Call Centre Staff - In house training

Data Entry Officer – In house training

Reporting and Analysis Staff – Trade qualifications, electrical engineering certificate or equivalent, in house training.

PB Associates notes the relatively high level of qualifications for initial fault attendance (operators). It is not uncommon for Distribution Businesses to utilise non-operator trained staff for initial fault attendance. It would be expected that the use of highly trained staff for initial fault attendance would improve the information obtained in relation to fault cause.

For planned outages a different process and system is used which also involves a significant amount of human input in both interpretation and input of reliability data. This process is described in more detail in section 5.3.2.

Interpretation of Data Captured

PB Associates has reviewed the "System Operations Report" form[12]. In general this form captures the systems assets affected and the fault location in reasonable detail. The cause entry area of this form does not directly relate to the Integral Energy System Fault Recording standards[13]. This difference requires the data entry officer to make certain assumptions or interpretations concerning the classification of fault causes and effects. Any potential detrimental outcomes of this discrepancy are likely to be mitigated by the use of a single data entry officer. PB Associates does not believe that this will cause any material reduction in the quality or accuracy of data provided to IPART for reliability reporting purposes.

Following the release of the National Regulatory Reporting framework for electricity Distribution Businesses by the ACCC in March 2002, Integral Energy has commenced updating of records to allow reliability data capture to be recorded by feeder. At this stage, individual feeders have been allocated to the SCNRRR definitions as described in section 5.3.3.

Weather Related Data

Integral Energy has been utilising a "3 minute storm" definition for approximately 3 years. In general terms this means that any severe-weather event that contributes more than 3 minutes to Integral Energy's annual SAIDI results is treated as an exclusion event for regulatory reliability reporting purposes.

Integral Energy has provided PB Associates with SAIDI "raw data" that includes the outage effects of 3-minute storms[14]. The data provided showed SAIDI, SAIFI and CAIDI figures for the periods 97/98 to 01/02 inclusive.

With the exception of 2001/2002, there are small differences between the raw data and the Integral Energy standard data over the aforementioned period. The most significant divergence between the raw data and standard data is in the year 01/02 where raw SAIDI was 737.18 against a modified SAIDI of 133.68. The storms that affected NSW over this period are recorded as contributing additional SAIDI of approximately 600 minutes (10 hours).

PB Associates notes that all outages that occur during a nominated 3-minute storm period are allocated as being storm related. PB Associates considers it likely that a number of outages would occur in or around this period that were not directly related to the severe weather event. This would be likely to result in a small discounting of the actual company SAIDI, SAIFI and CAIDI figures.

Due to the costs involved, PB Associates would not recommend that all outages that occur during a storm be reviewed to determine their direct association with the storm. Rather we would recommend that a consistent definition for storms be utilised across each Distribution Business.

[12] PB Associates Document register reference: IE158099A #5
[13] Integral Energy Document: WPB 1007, PB Associates Document register reference: 158099A #3
[14] PB Associates Document register reference: IE158099A #1

5.2.2 Network Performance Improvements

Reliability Measurement Improvements

Integral Energy has a large number of planned improvements to network reliability monitoring and reporting.

The most significant improvement planned by Integral Energy is the IAIMS project that is described in the Overview section (5.1) of this report. In particular, the Outage Management System component of the Distribution Management System will have a direct impact on improving the accuracy and consistency of reliability data.

In addition to the IAIMS project, Integral Energy has now installed a process whereby planned interruption information (minutes) is maintained on an individual feeder basis. The planned interruption data is further broken down by recloser or part feeder as well as by the categories of maintenance, construction, external construction, transmission and refurbishment. Integral Energy notes that this system is highly labour intensive at present.

Reliability Improvements

Integral Energy currently requires planned interruptions longer than 4 hours to be signed off by the relevant manager. The feeder monitoring of planned outages referred to above is then utilised to minimise the number of customers that experience more than 2 planned outages per annum.

Alternative work arrangements such as generators or live line may be employed where the soft-ceiling of 2 planned outages has been reached.

Integral Energy utilises on-site generation to limit the impact and severity of planned outages. At present, Integral Energy predominantly utilises non-synchronous generators requiring a shutdown during the transfer from line-of-mains supply.

The use of generators will improve the overall SAIDI and CAIDI reliability information. Integral Energy presently assumes a 10-minute changeover for non-synchronous generator connection and/or disconnection. The assumption of a standard ten minute interruption may lead to minor inconsistencies in reliability reporting as transfers could occur in less or greater time.

Integral Energy treats the dual outages required for generator transfer as a single outage for reporting purposes. This is a reasonable approach as to do otherwise would potentially distort SAIFI figures.

Integral Energy is presently trialing interrogatable through-fault indicators. These indicators may provide load and/or voltage conditions via a proximity-recording device and will aid in identifying fault locations and supply restorations times (CAIDI).

Integral Energy also currently has a team investigating ways of improving the reliability and performance of the network from a strategic perspective.

Integral Energy has provided PB Associates with clearly identified and documented network improvement plans. Both the Transmission Network Planning Review and the Distribution Works Program contain significant budgets for reliability projects for 2002/2003.

5.2.3 Audit Reports

Integral Energy has not undertaken or contracted any audit reports relating to the systems or processes for reliability data capture or reporting.

PB Associates was provided with a copy of an independent appraisal of the Integral Energy Electricity Network Management Report (August 2001)[15]. This report is a relatively short document and does not deal directly with reliability data capture or reporting.

5.3 DATA RELATING TO CUSTOMER INTERRUPTIONS AND DURATION

5.3.1 Customer numbers

Integral Energy defines "customers" as a connection between the distribution network and a customer that has been assigned a NMI (National Metering Identifier). There is a one-to-one relationship between a NMI and a premise and the customer is linked to the premise via an account.

The customer, premise, account and NMI information is stored in the Integral Energy customer information system (Banner), and also includes a link to a distribution substation for the majority of customers. Integral Energy estimate that in the areas covered by the old Prospect Electricity approximately 95% of customers have a link to a substation recorded, whilst in the old Illawarra region only 80% have a link to a substation established and recorded.

Total customer numbers used for calculation of reliability indices are extracted from the customer information system and an average of the customer numbers at the beginning and end of the 12 month period is taken for the total number of customers in the network.

Unmetered services such as street lighting and security lighting are assigned a NMI for each group of assets dependent upon the billing entity for these assets, therefore the number of NMIs assigned for these unmetered services is small in comparison with the actual number of streetlights etc. The NMIs for these assets are not connected to a specific premise.

The customer number total used for calculation of the reliability indices appears to be based on the number of NMIs in the customer information system and therefore includes unmetered services as described above, and vacant premises as these are not extracted from the total number.

At this stage there is no link between the customer details and the new feeder categories, CBD, Urban, Rural Short and Rural Long. For customers with a link to a distribution substation, these can be rolled up to a particular feeder, which is then classified based on its attributes into one of the feeder categories, however this connection of customers to feeder type is a manual process. Integral Energy is currently working on improving the link between customer and feeder type.

Inaccuracies generated in total customer numbers are mainly due to the inclusion of inactive premises in the total customer numbers. Using data extracted from the ESR system in January 2002 the total number of premises was 780,258 compared to 768,125 active premises. The comparison of these figures shows that the total customer numbers are overstated by up to 1.5%. This small percentage could be considered immaterial; the effect of this marginal overstatement of total customer numbers would be to reduce the reliability indices, thereby producing better than actual reliability statistics.

Finally, Integral Energy notes that "the total lack of linkages between our systems prevents us from identifying individual customers affected by interruptions that exceed any minimum. Therefore it would be impossible for us to accurately identify and pay customers eligible for any compensation".

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15 PB Associates Document Registration: IE158099A #13

5.3.2 Measuring number of customers affected

The method used to count affected customers for reliability reporting has developed over the last five years from a system where an estimated kVA per customer was used to estimate customers affected by an outage, to the current system where customer details are extracted from the customer information system (CCS). Different methods are currently used to estimate customer numbers for planned outages compared to unplanned outages.

Planned Outages

For planned outages a letterbox drop is carried out to notify customers of the outage a number of days prior to the outage occurring. A record is kept of all addresses where a notification card is dropped and this list is used to establish customer numbers affected by the outage. This method of establishing customers affected is considered to be highly accurate despite being a very manual approach.

Unplanned Outages

For unplanned outages customer numbers are established by interrogating the ESR (Emergency Service Reporting) system. Customer numbers are extracted from the customer information (CSS) data and used to update the ESR system and subsequently the SFR (System Fault Recording) system.

When an unplanned outage occurs the Network Performance and Process Review Officer interrogates ESR to determine the number of customers linked to a particular distribution substation that is affected by the outage and records this on the outage log sheet. The accuracy of the customer number depends on the linkages of customers to distribution substations held in the customer information system. As mentioned in the section above, 80% to 95% of customers (depending on the region) have been assigned to a substation. Integral Energy notes:

"… changes to the Customer Services System and the connection of new customers has meant that it has been difficult to maintain an accurate customer count. This is an on-going issue that is being partly addressed by the employment of two casual staff to assist in updating the accuracy of data in ESR. These staff will identify where the customer is connected to the network and assign them to a substation in ESR."

If the substation affected does not have customers linked to it, the Network Performance and Process Review Officer will review the system diagrams to estimate the number of customers affected by the outage by physically counting the number of service connections on the diagram.

From figures extracted from the ESR database in January 2002, the comparison of customer numbers connected to distribution substations (680,306) to the total customer numbers used for calculation of reliability indices (780,258) shows that approximately 12% of the customers are not allocated to substations. It is difficult to estimate the overall effect of this lack of data on the customers affected since the Network Performance and Process Review Officer estimates some customer numbers where a distribution substation has no customers allocated. The lack of connection of some customers to substations would be likely to under estimate the number of customers affected by an outage, this would be reflected in lower than actual reliability indices being calculated.

Adjustments to affected customer numbers

There are a number of circumstances where customer numbers extracted as described above are adjusted to take into account the details of a specific incident. For a single phase incident involving LV overhead lines the customer numbers on a substation are divided by two (i.e. two circuits of LV per substation), for underground areas the customers on a substation would be divided by four (i.e. four circuits of LV per substation).

Where a staged restoration has occurred and these stages have been recorded on the log sheet, the effect of the timing of the stages on customer numbers affected is taken into account based on the proportion of the feeder being switched back in.

Single Customer Outages

Single customer outages are not recorded for the purposes of reliability reporting. Customer calls relating to a single customer are recorded in SFR if it involves blowing an LV fuse at the substation. Single customer incidents are recorded in ESR for attention by regional staff only. The reported time is recorded but the restoration time is not recorded.

From experience in Australia, PB Associates estimates that the total contribution of single premises outages to overall SAIDI calculations is in the order of 2% to 7%.

Outages above 11kV

For incidents at voltages higher than 11kV customer numbers are aggregated as follows:

- Transmission Feeder – If a zone substation is lost then all the customers supplied by that zone are counted.

- For a zone substation fault – The feeders connected to the bus section affected by an outage are used as the basis for the calculation.

- For a transmission (TransGrid) fault – count of customers for each zone substation affected.

System Abnormalities

System abnormalities (e.g. load transfers and switching) can only be taken into account using the manual method where the system operator checks the pin board system diagrams in order to determine how the system is switched at the time of the outage and identify abnormalities.

If there are system abnormalities the operator may estimate a change in customer numbers affected based on the switching in place at the time. As this system is relies on the operator to check for abnormalities and manually estimate customer numbers there is opportunity for errors to occur, however it is not possible to quantify these potential errors.

5.3.3 Classification of Feeders

Integral Energy have interpreted the feeder classifications defined in the SCNRRR document as follows:

- **Rural Long** – Feeder over 200km long supplying a rural load.
- **Rural Short** – Feeder less than 200km long, predominantly rural load but can service a small amount of urban load.
- **Urban** – A feeder supplying in excess of 300kVA per km, can be Residential, Industrial or Commercial load in a recognised urban area.
- **CBD** – Business area serviced by feeders with a high redundancy factor.

The main difference apart from reversing the order of the stated categories is the inclusion in the "urban" definition of the words "*in a recognised urban area*". Integral Energy state that there would be no difference in the classification of their feeders using the definition above compared with the definitions as stated in the SCNRRR document.

In order to classify distribution feeder information the existing CAD/GIS (ArCAD) system has been used. The ArCAD system has been in use for a number of years and Integral Energy are in the process of updating this with the Intergraph GIS package. The original ArCAD was populated from hard copy drawings and updated with subsequent changes to the system, a full validation of this information has not been carried out, however if errors are identified during maintenance or other work, these are updated. Integral Energy considers the data held in this system to be 95% accurate.

Overhead and underground line lengths are extracted from the GIS in order to establish feeder classification. The distances produced are feeder route lengths, not circuit lengths.

5.3.4 Restoration Times

Restoration times, being the difference between the time the outage started and the time power was restored, are recorded differently for planned and unplanned outages. Unplanned outages are recorded manually on hard copy log sheets and later entered into the SFR (unplanned outages), or a summary spreadsheet (planned outages), for reporting purposes.

Planned outages are not recorded in SFR. They are recorded in a spreadsheet only and forwarded to Network Review and Compliance for inclusion in reliability reporting. The planned outages spreadsheet is completely separate to SFR and contains no linkage to the outage times for individual customers.

Planned Outages

For planned outages a "Disconnection & Reconnection Request" is submitted to the Systems Operation Branch. The request includes the planned start and finish times for the outage. When the outage actually takes place the field staff radio in to the Systems Operation Branch and the actual start and finish times for the outage are manually recorded on a log sheet for that day.

The following day paperwork containing the request is forwarded to a staff member in the Systems Operations Branch who checks the log sheet for the actual start and finish times of the outage. If actual outage times are more than 30 minutes outside the planned times, adjustments are made to the details on the hard copy form. Data from these forms is subsequently entered into a set of four separate spreadsheets, which are used to generate weekly, monthly and other reports for SAIDI and SAIFI. A planned outage summary page is sent through to the Network Review and Compliance Branch to be combined with data for unplanned outages.

Potential inaccuracies in the planned outage figures arise from:

- Instances where the actual outages times are different to the planned times by less than 30 minutes and as a result the times are not adjusted. This error would tend to overstate the outage time as a delayed start time or early finish time is not always captured.
- Manual recording of data by several different staff in different groups and data entry into numerous locations may also allow errors to occur.

Unplanned Outages

Occurrences of unplanned outages are firstly recorded by the call centre, based on customer calls, and entered into the ESR system, including customer details and some details of the fault if known. The ESR listing feeds through electronically to the control room and field staff are dispatched to rectify the fault. The control room operator then manually generates a hard copy "Systems Operation Branch Report" including the outage and restoration time, customers affected, details of the cause, and equipment affected by the outage.

All calls are logged into the ESR system however only those considered to fall within the reliability reporting requirements are logged for entry into the SFR system, for example single customer outages are not generally recorded and therefore are not contributing to the reliability statistics reported in the past.

The start time for the outage is recorded as either the time of the customer call or the time recorded by SCADA if available for the equipment concerned. The restoration time for the outage is taken from SCADA if available, otherwise restoration time is based on a report back to system control by the field staff and is manually entered by the control room operator.

Temporary interruptions and restorations that occur during fault isolation and restoration are recorded against the initial incident. Customer numbers are allocated to the faulted feeder.

Potential inaccuracies in the unplanned outage figures arise from:

- Single customer outages not being recorded.
- Inaccurate reporting or recording of times by either field crew or system control staff.
- Inaccurate data entry from log sheets.
- During storms (busy time in Control room) the duration is sometimes estimated as the actual is not known, eg interruptions to a single customer at a weekender with no one home to know about an interruption and advise.

5.3.5 Handling of Staged Restorations

Staged restoration occurs when a segment of the customers affected by an outage can be restored, whilst the remaining customers are restored at a later time allowing time for the affected equipment to be restored. In these cases an estimate is made of the number of customers affected based on the percentage of the feeder (all customers) that has been restored at each stage. For example in a case where bonds are burnt off, staging would be based on 2/3 of customers on feeder.

The timing of the intermediate stages of the restoration are based on reported switching times from the field operators and are recorded on the log sheets by the system controller.

Mobile generation is utilised to limit outage times in planned outages. A total transfer time of 10 minutes is allowed for non-synchronised generators.

5.3.6 Incident Causes

Integral Energy provided PB Associates with detailed information relating to the classification of incident causes. The primary source of information was contained in System Fault recording WPB 1007[16].

The WPB 1007 document details the following;

- System Fault Recording (SFR) Daily log sheet flowchart. A flowchart detailing the input of daily system fault information into the fault-recording database.

- Code descriptions for the entry of data into the SFR.

[16] PB Associates Document Reference: IE158099A #3

The code descriptions provided by document WPB 1007 provides for the capture of data relating to incident causes as well as other items relating to the incident. The upper level of coding details is as follows;

- Overview codes:
    - Weather at time of occurrence,
    - Occurrence Definition,
    - System Status,
    - System Voltage,
    - Local Government Area (Region),
    - System Type,
    - Fault Clearance.
- Causes:
    - Weather,
    - Birds, Animals, Insects,
    - Environment,
    - Third Part,
    - Causes by Integral Energy,
    - Causes by TransGrid,
    - Causes by Other.
- Effects:
    - Equipment/Manufacture.
- System Affected:
    - System Affected,
    - System ID,
    - Number of fault operations,
    - Circuit Voltage.
- System Fault Recording:
    - Equipment Effected Failed/Damaged,
    - Protection Operated,
    - Protection Alarms Only,
    - Follow Up Required,
    - System ID and Other Details,

- o System Address,
- o Comments,
- o Load Interrupted,
- o Restoration Date,
- o Restoration Time,
- o Percentage,
- o Total Supply Date,
- o Total Supply Time,
- o Next Report.

PB Associates notes that the above system of incident classification and cause identification is quite detailed. The documentation lists in excess of 70 sub-categories under the "causes" category.

Integral Energy has addressed the difficulties in consistency and training relating to the use of such a high number of causes by utilising a singe point of data entry for the SFR database.

While this has the advantage of increasing the consistency of data entry, the Integral Energy process does pose a risk in terms of the transfer of the incident information from the operators and EMSOs to the data entry officer. As detailed in section 5.2.1.

PB Associates has assessed this area and is of the opinion that a small degradation in data consistency may result in instances where the data entry officer is unavailable or changed. PB Associates has determined that the data issue will relate to the quality and consistency of cause information and will have little or no impact upon the primary SAIDI, SAIFI or CAIDI data.

The Integral Energy SFR system allows for the capture of primary and secondary causes. However, at present the system does not allow for the retrieval of secondary cause data. The access to secondary cause data is being addressed in the Cognos Impromptu reporting project described in section 5.2.1.

From the information provided to PB Associates it appeared that a consistent methodology for the recording of age and wear as a cause of equipment failure was not defined in then outage reporting systems. Integral Energy reported that age and wear evaluation of assets was undertaken via visual inspection of the faulted equipment.

The Integral Energy cause identification system provides a category for "Unknown" causes. The total number of unknown causes in 2000/2001 was 281 out of a total of 1292 High Voltage incidents. This represents a total of 22%. This is a relatively high percentage and is unusual given the use of trained operators for first line response.

5.3.7 Treatment of Data

The treatment of storm related incidents has been detailed previously in section 5.2.1. Other incident causes that may result in special treatment of data are TransGrid directed load shedding and generation incidents. PB Associates did not observe any incidents relating to generation or transmission load shedding and Integral Energy indicated that none had occurred in the last 5 years of reliability recording.

Integral Energy did confirm that only sustained outages are utilised in the calculation of SAIDI and SAIFI. The definition provided for a sustained outage was any outage in excess of 1 minute.

The treatment of repeat interruptions during fault restoration and multiple recloser operations is treated as one operation provided that at least one interruption was a sustained interruption.

The data utilised for SAIDI, SAIFI and CAIDI reliability reporting does not include transient information. Further detail on the information relating to transients and momentary data is provided in section 5.4.

Integral Energy reported that the collection and reporting of reliability data was "generally consistent" with the SCNRRR requirements. PB Associates did confirm that street lighting, and other unmetered supplies are not individually collected as part of reliability statistics. Unmetered supplies are typically aggregated in the Integral Energy Customer Information Systems into owner/customer grouping (e.g. Street lights by Council, Traffic lights to the RTA).

5.4 MOMENTARY INTERRUPTIONS AND POWER QUALITY

5.4.1 Power Quality

Integral Energy has provided PB Associates with three documents relating to the procedures for dealing with quality of supply issues;

1. Quality of Supply Management (NAT 6003)[17].
2. Quality of Supply Investigations (NAT 6006)[18].
3. Handling of Television and Radio Interference Customer Complaints (NAT 1561)[19].

The Quality of Supply Management document provides a brief description of roles and responsibilities relating to Quality of Supply investigations. The Quality of Supply Investigation document provides detailed information with respect to the process for investigations.

The basic outline of a Quality of Supply investigation is as follows;

- The investigation is initiated with a customer call and is registered on the ESR system.
- The customer site is visited by an EMSO to determine the need for voltage investigation.
- If a voltage investigation is required, the matter is referred to the Product Co-ordinator for the Quality of Supply team.
- The investigation is carried out by the Quality of Supply Team or by regional resources based on the complexity of the project.

The Quality of Supply Investigation procedures document an alternate means by which Quality of Supply complaints may enter the process. This is via a complaint directly from an MP, the MEU or ombudsman. PB Associates notes that in the case of such a complaint, the Integral Energy procedures appear to bypass the entry of the complaint into the ESR. This secondary process could result in the ESR reported figures for Quality of Supply investigations being lower than the actual figures.

[17] PB Associates Document Reference: IE158099a #17
[18] PB Associates Document Reference: IE158099a #16
[19] PB Associates Document Reference: IE158099a #18

5.4.2 Momentary interruptions

Consistent with the SCNRRR information, momentary outages are described by Integral Energy as non-sustained outages or outages of less than 1 minute. Integral Energy reported that the collection of MAIFI data capture is at present not complete.

SCADA information systems currently provide Integral Energy with MAIFI information relating to auto-reclose of high-voltage feeders and above. Information relating to the operation of pole-mounted reclosers is presently not provided in real-time and in some cases is incomplete.

Integral Energy is presently considering SCADA control of all pole-mounted reclosers. At present 6 Nulec reclosers are connected to the SCADA system. PB Associates considers that the implementation of complete automation and information reporting from the 250 Integral Energy reclosers will require a considerable expense as the present reclosers are mostly not communications enabled and the installation of communications to remote locations is difficult.

Cyclometer readings from non-automated reclosers are at present collected and entered manually into a stand-alone spreadsheet that is maintained by the control room staff. Collection is based upon maintenance or operations visits to the recloser site and some recloser cyclometers are reported to not be operational.

Transients are defined by Integral Energy as per IEEE 1159 as oscillatory and impulsive. Oscillatory transients are categorised as low, medium and high frequency. Impulsive transients are categorised as 5 nanosecond rise, 1 microsecond rise and 0.1 millisecond rise.

Transients are typically surveyed over a 1-week period on an as-need basis. Areas for transient investigation are identified via customer complaints and network investigation requirements (e.g. network planning).

The primary source of Integral Energy reported data relating to transient, voltage dips and worst served customers is the annual Network Management report to the Ministry of Energy and Utilities.

5.5 REPORTING OPTIONS

5.5.1 Historical Data

The Integral Energy reliability reporting systems are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

PB Associates considers that the Integral Energy systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information is available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information should also be available for both planned and unplanned outages.

The historical Integral Energy reliability data is not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates consider that it would not be possible to accurately determine this information from the existing systems.

The present day collection of MAIFI data is not complete. Based on this, PB Associates considers that the provision of historical MAIFI data would be of limited regulatory value.

The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

5.5.2 Energy not Delivered

Integral Energy was previously capturing and reporting energy not delivered from the SFR database. The measure is not presently being utilised but could be reinstated without considerable effort. The process would require a manual collection and reporting of the required information.

The information is presented in the units of "MVA hours lost".

Integral Energy reported that they are presently "not confident" in the data. The data does not represent all loads not supplied as any faults beyond the feeder CB are not collected.

It may be possible to collect recloser, sectionaliser and major feeder-spur faults through review of SCADA information. However, low voltage and smaller high voltage faults could not be obtained through the present systems.

The capture of "energy not delivered" is not presently envisaged within the Integral Energy DMS/OMS systems.

5.5.3 Faults per Kilometre

The capture of "faults per kilometre" information was recently implemented in parallel with the allocation of feeders to the SCNRRR definitions.

As for "energy not delivered", the present "faults per kilometre" measure only captures full feeder faults. The process is completely manual at present, but could be implemented as part of the DMS/OMS systems.

5.6 SUMMARY

Integral Energy has an active reliability measurement and reporting system that is generally in line with the definitions of the SCNRRR.

The Integral Energy reliability measurement systems currently require significant manual input and, in PB Associates' opinion, are reasonably labour intensive.

PB Associates has identified a number of areas where the current systems and processes will be contributing to reliability data that is not completely representative. The sources of these inconsistencies and their estimated impacts upon the current reliability data are provided in table 5.5 below.

It is important to note that the estimated impact figures provided below are highly qualitative in nature due to the lack of historical and supporting data. It is also not possible to summate the estimated impact figures as there are interrelations between each factor.

Potential sources of Data Inaccuracy	**Estimated Impact**[20]
Customers not allocated to Distribution Substations	+10% to +%15%

[20] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

Inactive and unmetered customers in base customers	-1.5% to 0%
LV single premises outages not captured	+2% to +7%
Base-load outages allocated to Storm	+0% to +2%
LV Circuit allocations	-3% to +3%
Phase allocation	-2% to +2%
10 minute Generator cross-over	-1% to 0%
System Abnormal outages	-1% to +1%
Non-operational recloser cyclometers	Relates only to MAIFI data
Overall estimate of reliability data Inaccuracy	**-5% to 20%**

Table 5.5

Integral Energy has had reasonably robust data capture and reporting systems in place since the systems were centralised in 1997/1998. Since this time, Integral Energy has implemented a number of projects to improve the accuracy and consistency of reliability data.

As a result of the improvements in reliability data capture, the overall reliability statistics for Integral Energy have shown an unfavourable trend. It is PB Associates' opinion that improvements in reliability data capture by Integral Energy over the past 5-year period have contributed towards worsening reliability statistics. This observation particularly applies to the SAIDI and SAIFI indices. CAIDI indices may be expected to improve (reduce) due to smaller outages typically taking less time to restore.

Due to the lack of available data, it is not possible for PB Associates to quantify the exact increase (in terms of SAIDI or SAIFI) that has been due to reliability measurement improvements.

Integral Energy has a significant project currently in progress (IAIMS) that encompasses changes to many of the core Integral Energy network systems. Part of the IAIMS project is a proposal to radically improve the processes and systems whereby Integral Energy captures and reports reliability performance statistics.

The information provided to PB Associates indicates that the IAIMS project is likely to address many of the items identified in this report. If the IAIMS project were implemented as described, PB Associates would anticipate a significant improvement to the accuracy of data reported for regulatory purposes.

Integral Energy reports that the IAIMS project has been identified in the 10-year Strategic Asset Management Plan 2002-2012[21]. The total cost of the IAIMS project is approximately $25 Million and a portion of this expenditure is allocated to the DMS/OMS sub-project for expenditure up to and including 2003/2004.

PB Associates would anticipate that the reliability statistics that are presently reported by Integral Energy would alter in the future due to the IAIMS project. Should the historical trend of reliability data improvements continue, PB Associates would expect that this would contribute to a worsening in overall reported reliability statistics (SAIDI and SAIFI).

[21] PB Associates Document Reference: IE158099A #12

6. ENERGYAUSTRALIA

6.1 OVERVIEW

PB Associates representatives visited the offices of EnergyAustralia at Sydney and Wallsend over a four-day period to review the reliability reporting processes. Supplementary information has been supplied to PB Associates subsequent to the onsite visits. The review was carried out in accordance with Australian Auditing Standard AUS 810[22].

EnergyAustralia undertakes the analysis of reliability data centrally at its head office in Sydney. However, different systems are used in what were formerly the Sydney Electricity and Orion Energy parts of the organisation for the capture and storage of the initial data. Accordingly, the two centres were visited to gain an understanding of both processes.

The Sydney Electricity network consists of what is known as the Sydney Metro and Central Coast Regions (hereafter referred to as Sydney region). The Orion Energy area consists of what is known as the Newcastle and Hunter Valley (hereafter referred to as the Newcastle region). A portion of the Orion Energy area was transferred to NorthPower at the time of the formation of EnergyAustralia.

Upon arrival at EnergyAustralia, PB Associates were advised that the questionnaire had not been filled due to the shortness of available time and pressures of other commitments. This was the case for both the Sydney and Wallsend offices. However, following discussion a commitment was made to provide the completed questionnaire within a day or so of the end of the visits.

The interviews at both Sydney and Wallsend were conducted utilising the questionnaire items as the basis of discussion.

Information Systems

EnergyAustralia has published a document titled ES2 Electricity Supply Standards[23] a copy of which was provided to PB Associates. This document, prepared in accordance with the Electricity Association of NSW Code of Practice – Electricity Supply Standards sets out EnergyAustralia's objectives in terms of the maximum number of occasions on which supply to the customer' supply point is interrupted by an unplanned outage (ranging from 6 interruptions per year in Sydney to 20 interruptions per year in Muswellbrook) and the average number and duration of interruptions (ranging from 1 interruption per year of 30 minutes in Sydney to 7 interruptions per year totalling 270 minutes in Muswellbrook).

One of the aims of the information systems is to be able to monitor the performance of the network and to be able to verify compliance with EnergyAustralia's own objectives. These objectives are established as a part of its Statement of Corporate Intent with its shareholder and monitored regularly by the Board. Additionally, the information system seeks to meet the reporting requirements of the Ministry of Energy & Utilities and IPART.

The current EnergyAustralia systems for capturing and reporting reliability information are as follows:

Common to all of EnergyAustralia

- CCS Customer Care System (SAP)

[22] Special Purpose Reports on the Effectiveness of Control Procedures.
[23] PB Associates Document register reference EA158099B #1

- CASS Customer Aided Service System (Sybase)
- BES Business Enterprise System (SAP)
- MBS Metering Billing System (SAP)
- TIS Technical Information System (IDMS)
- SOL System Operator Log (Lotus Notes)

Specific to Sydney region:

- FODS Fault Outage and Defective Apparatus System (subset of TIS) (IDMS/ OLQ (On line query))
- NRD Network Reporting Database (DB2/SQL)
- DW Data Warehouse (Business Objects)

Specific to Newcastle region:

- NCA Network Control Applications (Dbase, FoxPro Tables, Windows)

  Incorporating LID Line Impedance Data

  Switch & Feeder Connectivity

  Planned and Unplanned Outages

  Outage Requests

Integration of the Sydney region and Newcastle region data for the purpose of reliability analysis occurs via a weekly download of data from the Newcastle region area into the NRD Network Reporting Database.

In addition, a daily download occurs from the Newcastle region data as input into the SOL.

The substation equipment and transformer data for the Newcastle region was integrated with the NCA through SET the "Substation Equipment & Transformer" data that was a PC based system. However, with the adoption of TIS for all of EnergyAustralia, this integration no longer exists.

Relationships between the various systems is described in Figure 6-1

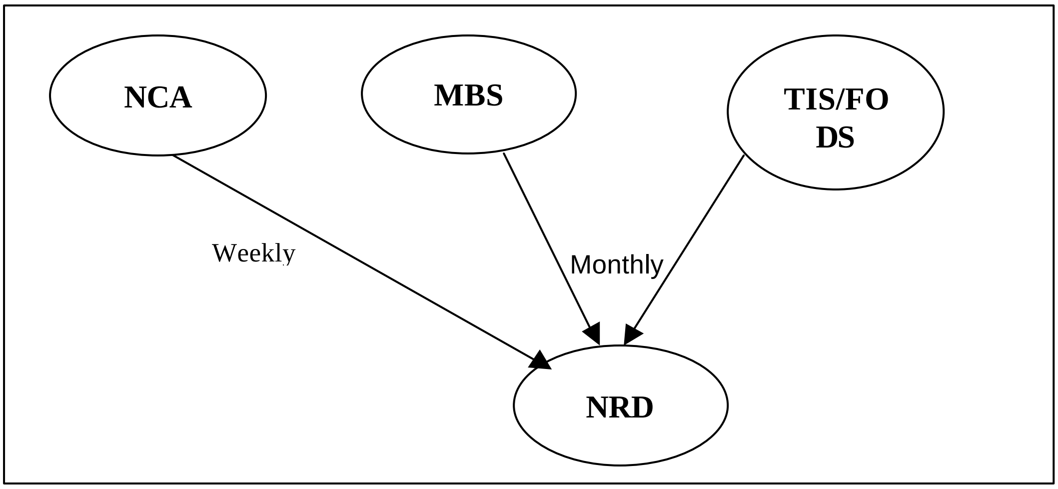

Figure 6-1

Note: The links between systems indicated above are illustrative and more complex in reality.

There are fundamental differences between the Sydney region and Newcastle region systems in terms of the structure and "user-friendliness" of the systems. These are discussed in more detail below. In particular, the computer operating system utilised for Sydney region is considered to be "difficult" and not "user friendly" whereas the Newcastle region has been integrated as a Windows based user interface, the recording process of planned and unplanned interruptions is different and the method of dealing with the number of customers connected to the network is different.

The TIS system is an in-house developed system (and supported by the external and internal IT providers) that has been used by EnergyAustralia (Sydney region) since the early 1980's.

Future Information System Works

EnergyAustralia is currently in the process of implementing a new GIS system utilising the Smallworld GIS. It is expected that this project, which has been underway for some time, will be completed by the end of 2002.

Associated with this project, a trial is being undertaken within the Sydney region area to explore the possibility and practicality of establishing a linkage between the customer network connection and the corresponding National Market Indicators NMI. However, early indications are that there are data quality issues within the existing database that will present significant challenges to establish the linkage.

A new Distribution Network Management System (DNMS) is currently being implemented. Logica is supplying the system. The objective of this project is to replace the current operating diagrams associated with the 11kV system that are presently manually drawn utilising AutoCAD with computer generated diagrams. This will provide on-line connectivity of the network and automatic logging of activity on the network. A certain amount of linkage is being provided with respect to the GIS project by extracting the rating of the elements from the GIS.

FODS is not being replaced by this project. Hardware / software associated with this system is in the factory testing stage. A project is due for completion in mid-2003 to undertake data cleansing of the DNMS data prior to commencing rollout. It is expected that rollout of the DNMS will commence mid 2003. However, full implementation is not expected until the end of 2004.

A proposal to proceed with a major Network Asset Management System (NAMS) was considered by EnergyAustralia in recent years. This project was intended to establish an integrated network asset management system. However, the proposal was not compatible with the corporate business enterprise system (SAP) that has been established within EnergyAustralia for its billing, financial and customer management system and accordingly it did not receive support. In addition, various individual initiatives are being undertaken to achieve improvements.

Currently a new version release of SAP is being implemented. The asset management module of the system is being tested with a view to being used as the basis of the proposed Works and Asset Maintenance Management System (WAMMS) in the transmission area. The objective ultimately is to replace the TIS and Pole and Pillars systems into the integrated WAMMS on the SAP platform. It is not presently clear as to how it is intended to implement this module should the trial be successful.

The Meter & Billing System is a DB2 based system. The feasibility of transferring this system to an alternate system is currently being investigated.

PB Associates considers that the proposed systems referred to above will have a material impact upon improving the consistency and accuracy of the EnergyAustralia reliability measurement systems. The present capital expenditure with respect to network related IT&T over the period 2002/03 to 2005/06 is $26M.

As the detailed specifications and documentation for the proposed systems are not presently available, it is not possible to quantify the exact improvements that these new systems will have on reliability reporting.

6.2 POLICIES, SYSTEMS, PROCEDURES AND AUDIT

6.2.1 Network Reliability Reporting

IT Systems

The primary EnergyAustralia system for reliability reporting is the Faults Outage & Defective Apparatus System (FODS). The input and control of data being entered into FODS is described in EnergyAustralia document on Network Security. A copy of Sec05 of the document was supplied to PB Associates[24].

FODS was created in 1988 and is a subset of the overall Technical Information System (TIS). TIS is a mainframe computer system developed under IBM's IDMS database structure. Support is provided both from an external provider and internal resources.

The Technical Information System is a comprehensive data base of all of the substation elements of the network containing information related to substations, transformers, switchgear and end components down to the low voltage distributor level of a distribution centre (substation).

The TIS also includes details of the connectivity of the substations and switches along a feeder. It does not contain details of the characteristics associated with lines and cables joining the elements.

From the connectivity perspective, when an interruption occurs, details of all substations affected by the interruption can be identified. When partial restoration occurs, the network can be segmented according to which areas are re-energised.

FOD was developed in-house for the Sydney region and is largely unchanged from its original development. Due to its "main-frame" nature and not being a client-server type system, it is not seen to be user-friendly, it is considered difficult to train staff in, and relies on subject matter experts to input and extract data. Knowledge of the system has been transferred through on-the-job learning and mentoring from skilled staff. A limited number of staff are presently familiar with this system. Apart from the original manuals (which are not currently used), operating manuals associated with the system are not available.

A major challenge that has faced users of the Sydney region system has been the lack of tools to readily extract data from the system and to run queries. In recent years "Business Objects" is being introduced at the corporate level to improve the ability to extract data. However, this tool is not able to access the IDMS structure of FODS and TIS. Data from NRD is transferred to a data warehouse that can then be interrogated by Business Objects.

As referred to above, the development of the Newcastle region information system commenced in the early 1990's and evolved from essentially PC based solutions. Original developments were individual DOS based applications.

Development of the applications has continued with the applications being transferred to a Windows based environment and with the integration of the various separate applications into what is now known as the NCA. The foundation element of this package of applications is the Line Impedance Data module (LID). This module creates the relationship between each of the switches and substations in the network. As the name

[24] PB Associates Document register reference: EA158099B #2

implies, it is also the source of data utilised by the network planners and protection engineers for carrying out network analysis and protection studies. In the original development this package of modules also interacted with Substation Equipment and Transformer (SET) module as well as the Customer Information System. However, these linkages have been replaced with batch transfers as mainframe systems are implemented across the business.

The FODS system is used to record all outages that a substation or in the case of the Sydney region area, the circuit from the substation may have experienced. The principal source of data comes to the system operator from the Computer Aided Service System (CASS) and from the EnergyAustralia SCADA system.

An IT strategic plan is presently under development by EnergyAustralia and an organisational restructure is currently underway within the Networks area of EnergyAustralia.

The Business Processes and Development group has been tasked with a role to attend to the development and ongoing effectiveness of systems and processes to support the Network Business. A draft Network IT&T Strategy Plan for 2002/03 was provided to PB Associates[25], which projects the development and conversion of existing applications to 2005/06.

Human Input

The level of human involvement in reliability data collection is moderate for the Sydney region and relatively low for the Hunter Valley area.

As previously mentioned, there are two main operations centres within EnergyAustralia - One in Sydney and one in Wallsend. The main inputs to the operators on the status of the network are from the SCADA system, input from the Customer Aided Service System (CASS) and communication from field operators.

For unplanned outages, fault calls are received from the EnergyAustralia Call Centre or directly via the SCADA system. The fault is registered in the CASS system. A system dispatcher then assigns the call to an EmSO (Emergency Service Officer) in the case of service faults who is then responsible for initial attendance and assessment. If more than three calls are registered from an area, the CASS system identifies the fault as a network fault and is referred to the system operator to arrange for an operator to attend and assess.

If asset replacement or repair is required to rectify a fault the Operator or EmSO refers the call to the local depot. If no replacements or repairs are required, the operator or EmSO undertakes inspection and restoration, and the information relayed back to the system operations.

At the Sydney centre, the logging of activity and reporting are manual entered on what is referred to as the "Blue Sheet". Data entry associated with planned and unplanned interruptions is undertaken subsequently by skilled staff.

At the Wallsend centre, abnormal switching is manually logged on a switching sheet. The system operator responsible for the particular desk handles all data entry associated with planned and unplanned interruptions.

At the Sydney operations centre, the "Blue Sheet" ("Interruption Report/Unusual Occurrence" form (A118)) is completed recording all relevant details associated with the incident. This data is later interpreted by skilled technical officers and entered into the FODS system.

[25] PB Associates Document register reference: EA158099B #29

At the Wallsend centre, the system operator enters all switching activity on an "Emergency Switching Sheet" but enters all of the data associated with fault reporting directly on-line through the NCA system.

The general level of training/qualifications of those involved in the fault reporting process is described below;

Fault Attendees (referred to EmSOs (Emergency System Operators) and DOPs (District Operators):– Electrical trade qualified with training (EmSOs – 6 weeks; DOPs – 3years) and a minimum of 2 years experience.

Network Operators – Have all been DOPs

Dispatchers – Have all been DOPs

Call Centre Staff - In house training

Data Entry Officer – Data collected by Network Operators. Technical officer support staff (trade qualifications, electrical engineering certificate or equivalent, in house training) transfer data to FODS database in the Sydney region. Network Operators input data in the Newcastle region.

Reporting and Analysis Staff – Specialist reporting staff in the Sydney region and Network Operations Manager (Trade qualifications, electrical engineering certificate or equivalent) in the Newcastle region.

Implementation of SCNRRR framework

EnergyAustralia is in the process of responding to the requirements of the National Regulatory Reporting framework for Electricity Distribution Businesses as published by the ACCC in March 2002. However, this task will not be completed until the end of 2002/2003. The nature of the FODS and NRD databases is such that EnergyAustralia believe that they will be able to undertake the required interrogation of the database at the end of the 2002/2003 year to produce the details required.

In order to be able to carry out the classification of feeders in accordance with the CBD, Urban, Rural Short and Rural Long feeders, EnergyAustralia need to collect data associated with feeder lengths and maximum demand of feeders. Until the GIS implementation is complete, EnergyAustralia are unable to reconcile feeder lengths between the GIS and the TIS databases. It is expected that this will be completed at the end of 2002.

With respect to maximum demand of feeders, EnergyAustralia propose to take the 10 maximum 15 minute period demands on the feeders, apply an algorithm to filter out maximum demands on feeders that are as a result of abnormal switching conditions and then classify the feeders according to whether they are Urban, Rural Short or Rural Long.

With respect to CBD feeders, EnergyAustralia propose to classify the parts of the Sydney CBD supplied by the triplex feeder system as CBD. For the rest of the feeders, it is proposed to classify the feeders as Urban. A triplex feeder exists at Newcastle in the CBD area. However, EnergyAustralia consider that the limited extent of this system and lack of redundancy makes it a normal Urban feeder and not a CBD feeder.

As CBD feeders are defined as feeders having a higher than normal level of redundancy, PB Associates consider that it is reasonable to assume that only the Triplex system in Sydney meets the CBD definition in accordance with SCNRRR. However, there is a more general issue that needs to be addressed in terms of what should constitute a CBD area for the purpose of reliability measurement. .

A pilot process is currently underway to incorporate National Market Indicators (NMIs) into the GIS which will provide customer connectivity information.

Interpretation of Data Captured

The "Interruption Report/Unusual Occurrence" form (A118) used at the Sydney operations centre provides the complete details as recorded by the operator of all of the circumstances associated with the event, be it a LV Interruption, HV Interruption or Unusual Occurrence.

The report form includes a description of all of the circumstances associated with the event, the times of the event, details and times of switching and restorations, weather conditions, loading conditions, protection operation and cause.

The cause entry of this form does not directly relate to the EnergyAustralia cause categories as identified on their cause category schedule[26]. The assessment of the cause code is undertaken by one of the three data entry officers to make certain assumptions or interpretations concerning the classification of fault causes and effects. As experienced staff are utilised to undertake the categorisation, PB Associates do not believe that this will cause a material reduction in the quality of the data provided to IPART for reliability reporting purposes.

Weather Related Data

It is clear that the issue of application of the classification of a "3 minute storm" is of concern to EnergyAustralia. The determination that an event is a "3 minute storm" is one that is typically made after the event. It is a function of how wide spread the storm event was and the speed of response. PB Associates notes a possible scenario where, the slower the response, or perhaps the poorer the protection discrimination causing more widespread outages, the greater the chance that a marginal "3 minute storm" could become classified as 3 minute.

EnergyAustralia believes that the SCNRRR rule for excluded events is inappropriate in that it disadvantages those DNSP's with larger customer bases. They believe that a more appropriate basis would be a statistical basis that would exclude those events that can be defined statistically as extreme events.

Previously, EnergyAustralia differentiated between a major and minor storm on the basis of the following criteria:

> **"Major Storm** has occurred when the weather conditions have caused more than one of the following. More than: -
>
> - 40 HV feeder operations, or
> - 200 LV fuse operations, or
> - 50 000 customers affected.

If none of the above criteria have been exceeded, the storm is to be considered **Minor** for the purposes of FODS entry."

It is also noted that as the measure proposed by SCNRRR is related to NMIs that are equivalent to active accounts within the Distribution Business system, the measures of SAIDI, SAIFI and CAIDI do not reflect the number of people affected but rather the number of services. Accordingly, a major event affecting a large number of people (such as complete high rise buildings, major shopping centres or factory complexes which house hundreds of people) could be covered by just a single NMI and would have negligible impact in terms of measurement of a 3-minute event.

PB Associates consider that there is a need to further review the issue of excluded events and the potential use of a statistically based process.

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[26] [26] PB Associates Document register reference: EA158099B #9

PB Associates notes that all outages that occur during a nominated 3-minute storm period are allocated as being storm related. PB Associates considers it likely that a number of outages would occur in or around this period that were not directly related to the severe weather event. This would be likely to result in a small discounting of the actual company SAIDI, SAIFI and CAIDI figures.

Due to the costs involved, PB Associates would not recommend that all outages that occur during a storm be reviewed to determine their direct association with the storm. Rather we would recommend that a consistent definition for storms be utilised across each Distribution Business and that figures be published with and without the inclusion of the storm event.

The classification of weather conditions and the monitoring of the data is an area of inconsistency. It is undertaken in accordance with the guidelines established by the Ministry of Energy & Utilities. Although the Sydney control room monitors the conditions at 4 weather stations within its area, the weather conditions classifications are not defined according to any numeric parameters.

6.2.2 Network Performance Improvements

Reliability Measurement Improvements

In the short-medium term the major planned improvement in reliability measurement is to implement the DNMS system. This system will provide an electronic network management system that would incorporate the "Blue Sheet" process into an electronic system. The system is expected to be completed by June 2003 although it is not expected to be fully implemented until end 2004.

In the medium to longer term EnergyAustralia expect that the GIS will be populated with NMI information that will enable the reliability reporting to be based on actual customer numbers rather than estimated numbers.

Reliability Improvements

As referred to above, EnergyAustralia currently publishes Electricity Supply Standard (ES2). This standard outlines EnergyAustralia's supply availability objectives.

In the Sydney Metro region, the configuration, redundancy and capability of the network means that the reliability of supply is relatively high. With the combination of the configuration of the network and use of generators, the extent of planned interruptions is minimised.

EnergyAustralia is participating in the ESAA Power Quality Survey being carried out by the University of Wollongong in monitoring the impacts of sags and various power quality parameters in order to better understand strategies for network improvements.

6.2.3 Audit Reports

EnergyAustralia has had an audit relating to the "System Data & Performance" process within the Network Planning undertaken by David Bendeich as part of EnergyAustralia's own internal audit procedures in February 02.

PB Associates was provided with a copy of the appraisal[27]. This report is a relatively short document and deals in a global sense with the reliability data capture and reporting process. It is noted that amongst the observations of the report a recommendation is made that the production of descriptions of the key steps of the process, including data sources and data checking may be beneficial.

[27] PB Associates Document register reference: EA158099A #3

6.3 DATA RELATING TO CUSTOMER INTERRUPTIONS AND DURATION

6.3.1 Customer numbers

A limited number of CRNP (Cost Reflective Network Pricing) customers who connect at high voltage are the only customer group identified at a voltage level. All other customers are defined with reference to an account number within the MBS database. EnergyAustralia treats the account number as equivalent to an active billing account.

The number of customers connected at various voltage levels can be established from the MBS database. However, this is not seen as being material as most customers are connected at low voltage.

EnergyAustralia has indicated that it is intended to shift towards the use of NMIs as the measure of customer numbers.

In the Sydney region, each customer is defined as being within a particular postcode area. No detail is kept of the linkage of the customer to a distribution centre (substation).

In the Newcastle region, prior to integration of the data systems with that of the Sydney region, a link between the customer and the distribution substation existed. However this link is no longer being maintained or populated with data. Accordingly, the quality of this data is deteriorating with age.

The total number of customers used for calculation of reliability indices is extracted from the MBS and is taken as the total number of customers that exist on the version of the database at the time that the report is being prepared.

Unmetered services such as street lighting and security lighting are not currently included in the count of customer numbers. NMIs for unmetered services are assigned for each group of assets depending upon the billing entity for these assets. PB Associates notes that when NMIs are adopted for counting customer numbers, the number of NMIs relating to unmetered services will represent a small percentage of the total.

At present there is no direct link between the customer details and the new feeder categories, CBD, Urban, Rural Short and Rural Long. In the NRD (Network Reporting Database), in the Sydney region, an allocation is made of the number of customers per distribution centre circuit, and in the Newcastle region, the number of customers per substation is allocated. Accordingly, once the various feeders are categorised according to the type of feeder, the total number of customers per feeder or feeder section can be extracted.

Total customer numbers are derived from active accounts. Therefore, with the exception of any customer accounts that are missing and therefore not being billed at all, the total customer numbers should be an accurate assessment.

Due to the manner in which the customer numbers are allocated per circuit (as described below), the smaller the feeder or section length, the greater the potential error in the number of customers in that section. However, as the number of substations per feeder is reasonably large, the actual errors are reduced.

Vacant premises, which do not have an active account, are not included in the customer count.

Customer numbers are updated and reviewed at the end of each month. Period reporting uses the average customer numbers for the period.

6.3.2 Measuring number of customers affected

Customers are not classified by voltage level other than CRNP customers (HV). The methodology utilised for measuring the number of customers affected by planned and unplanned interruptions (high voltage or low voltage) in the Sydney region is a structured estimate based on the number of low voltage distributors for distribution centres. This is based on an averaging method to estimate the average number of customers per low voltage distributor for the substations within a given postcode area.

The calculation is carried out by summing the total number of low voltage distributors of all of the distribution centres within a postcode area. For the same postcode area the total number of customers is extracted from the MBS system.

The number of customers per circuit is calculated as:

$$\text{Number of customers per distributor} = \frac{\text{Number of customers in postcode area}}{\text{Number of circuits in postcode area}}$$

The resultant number is expressed as an integer and allocated as the number of customers per circuit. This computation is carried out monthly utilising the number of active accounts in a postcode area. The number of customers per distributor is retained in the historical records.

EnergyAustralia provided a listing of the number of customers per circuit currently applicable[28]. The spread of customers per distributors ranged from a low of 1 to a high of 91 with an average of 40 and a standard deviation 16.6 per postcode. When carrying out a weighted average based on the total number of distributors, the average number of customers is 36 and a standard deviation of 14.6.

On a local basis the number of customers affected by an outage is very much an approximation and does not take into account the variability of the number of customers per distributor, the rating of the substation and variability in population/business density of active accounts.

This approach has been adopted as an approximation on the basis that the rating of distributors from distribution centres would tend, on a weighted average basis, have a relatively constant value. However, the spread of customers per distributor indicates that this averaging approach, at least on a local level, and probably feeder basis provides a high degree of error in the estimate of the number of customers.

EnergyAustralia have indicated that the error on a feeder basis could be 5%. A detailed justification of this assessment has not been presented and variations of 15% to 25% can be demonstrated from practical theoretical examples. Previous detailed studies by EnergyAustralia demonstrated that the magnitude of the error in some extreme circumstances could be in excess of 60%. The greater the extent of the outage, the lower the error overall. There would be errors, both in the positive and negative direction with respect to individual feeders.

In the Newcastle region, the methodology that has been used to allocate the number of customers per substation was previously based on a direct linkage between the customer and the relevant substation number. However, since the time that the linkage has been disrupted and the data has not been maintained, the number of customers for substations that existed at the time of the change has been kept the same. Currently 70% – 80% of customers have a substation number allocated. The difference between the number of customers allocated to substations and total number of customers is divided into the total kVA rating of all substations that have no customers allocated (ie. all new substations since the change of process).

The number of customers for each substation that has no customers allocated is attributed according to the kVA rating of the substation for the purpose of reliability reporting.

It can be seen from this, that the "number of customers per substation" record is deteriorating with time as all new customers are attributed to new substations and not to

[28] PB Associates Document Reference: EA158099B #8

existing substations. Accordingly, the load density in the older areas is not being allowed to increase, unless new substations are added. The number of customers in new areas is most likely being overstated.

Adjustments to affected customer numbers

In the Sydney region there are a number of circumstances where the number of customers per distributor is adjusted to take into account the details of a specific incident. For a single-phase fault on the LV network, one third of the number of customers is taken as being the number of customers per distributor. It depends on the balance of customers on the particular distributor as to whether this is a correct estimate. An error of the order of 1% is possible.

In the Newcastle region, no adjustments are made for single-phase faults. Indeed, the system operators make no data entries with respect to low voltage network faults other than those related to substation fuses.

Single Customer Outages

In the Sydney region, single customer outages are only recorded in the reliability reporting system where the outage is as a result of a network related incident. This would occur when the MSO refers a network incident back to the control room to handle a network fault.

In the Newcastle region, single customer incidents are not incorporated into the reliability reporting system.

From experience in Australia, PB Associates estimates that the total contribution of single premises outages to overall SAIDI calculations is in the order of 2% to 7%.

Outages above 11kV

For the Sydney region, the TIS provides connectivity to aggregate the number of distribution centres affected by the incident. The incident is then attributed to all of the distribution centres that have been affected by the incident.

Similarly, in the Newcastle region, the number of customers affected is aggregated by tracing the "normal" network and faults are allocated to all substations downstream of the higher voltage outage. . Should the network be in an abnormal state, the "paragraphing" facility used for staged restorations could be used to collate all the substations affected by the fault. However, it is a function of the diligence of the system operator as to whether this is done.

Other issues re inconsistencies and/or inaccuracies

EnergyAustralia understand that any method other than direct counting of customers is an estimate and believes that the postcode method provides a reasonable estimate in the absence of direct connectivity. As the major contributors to "lost customer minutes" are 11kV feeders, EnergyAustralia feel that relative accuracy will be high and the errors associated with staged restorations and low voltage faults will be low.

PB Associates have undertaken an assessment of the impact of the utilisation of postcode method for the purpose of production of SAIDI, SAIFI and CAIDI on an individual feeder basis in accordance with the requirements of SCNRRR. It is clear from this assessment that the overall performance factor is quite accurate as actual number of customers in such an area is accurately known. The number of customers per postcode area varies substantially. The number of customers in a postcode area typically varies from 6000 to 15000 with a wide variation. The maximum number is approx 31000 for postcode 2250 (Gosford).

Where the estimated number of customers is based on the computation of the average number of customers per distributor within a distribution centre, the error on an individual basis can be extremely high. As referred to earlier, EnergyAustralia demonstrated in an earlier study associated with rural feeders, that the error level could be as high as 64%.

In simple studies undertaken by PB Associates of practical examples where there are a variety of loads per customer, very wide variations in the SAIDI, SAIFI and CAIDI of individual feeders occur in the range ±15% to ± 25%. (Information provided by EnergyAustralia subsequent to the audit visit).

On the other hand, EnergyAustralia has a very comprehensive database of the outage performance of all distributors in the Sydney region and distribution centres in the case of the Newcastle region. EnergyAustralia is able to examine the number and duration of all interruptions to any customer in their area since the early 1990's. The performance of all distribution centres in terms of outages (duration and frequency) can be analysed and statistical distributions prepared. However, this approach does not align with the agreed SCNRRR approach.

A further area of potential error arises from the impact of works undertaken by Accredited Service Providers (ASP's) at the low voltage level, particularly in relation to services. A customer interruption as a result of activity of ASP's is not presently captured. PB Associates considers that the potential contribution of these works to reliability statistics to be non-material.

System Abnormalities

System abnormalities are taken into account in both the Sydney region and the Newcastle region, although it relies on the data entry staff and the system operators respectively to identify configuration of the network at the time of fault.

A random sample of outages involving abnormal conditions was examined in both Sydney and Newcastle regions and it indicated that recording of system abnormalities and staged restoration is undertaken reasonably accurately.

6.3.3 Classification of feeders

EnergyAustralia advises that the GIS computer system database will be used as the basis for determining feeder route length for categorisation of rural feeders. CBD feeders will be those Sydney CBD feeders supplied by the triplex system. The balance of feeders will be identified as urban.

In the Newcastle region, the present method of determining route length is from the Line Impedance Data that is based on circuit length rather that route length. As the source of this data has been based on an assessment of the impedance of the element, the level of precision of this record is only expected to be in the region of 85% – 90%. However, as the same people carry out all of the updates in the Newcastle region at the same time, it is likely that there is high level of consistency of data entry.

For the purpose of categorisation of feeders according to Urban, Rural Short and Rural Long, the maximum demand of the feeders is to be taken from the SCADA system and an algorithm will be applied to filter out abnormal switching loads and to apply to definition as required by SCNRRR.

The GIS database will be able to differentiate between overhead and underground records. However, it is unclear at this stage the level of accuracy that will be available to determine the route length of "in-service" underground cables within the urban area. It is expected to be available for the whole of EnergyAustralia by December 2002. EnergyAustralia estimate that the error is likely only to be of the order of 1.5%.

Parallel cables will be eliminated from the total count. Standby feeders that provide redundancy of supply will be classified as for the main supply feeders. This is necessary as the SCADA load on such feeders could be zero for the reference period and would otherwise be classified as rural.

Until the GIS system is finalised, route lengths are not available. Considerable effort is being put into ensuring that the data within the GIS is as accurate as possible. To date, no audit has been undertaken to check the route length or reconcile the primary record although the audit of lengths is a prime component of regulatory asset valuations.

6.3.4 Restoration Times

Restoration times are recorded slightly differently for planned and unplanned outages.

In the case of interruptions on a part of the network that is connected via SCADA the incident is "event recorded" via the SCADA system. In the Sydney region, network operations procedures require the incident and subsequent action to be recorded on the "blue sheet" process. In the Newcastle region, the event is recorded on a switching sheet and entered into the NAC system directly.

A summary of the event and stages of the restoration process is entered into the SOL Lotus notes database. Within the following 24 hours, technical officers enter the details of the incident into the FODS database within the Sydney region. In the Newcastle region, a daily download occurs to incorporate the Newcastle region into the SOL Lotus notes database.

Planned Outages

For planned outages, which are more predominant in the Newcastle region and the Central Coast area (generators, low voltage parallels and high voltage switching is used to minimise the need for planned outages in the Sydney Metro region), a request is submitted to the Network Control Branch at least four days before the required interruption. The request includes the planned start and finish times for the outage. A computerised process has been implemented to prepare the switching instructions. When the outage actually takes place the field staff radio in to the Network Control Branch and the actual start and finish times for the outage are manually recorded on the planned switching sheet.

The following day paperwork containing the request is forwarded to the data entry officers who make the adjustments to the actual disconnection and reconnection times. Data is recorded in the FODS system of the outage.

Unplanned Outages

For HV, interruption times are recorded automatically via an event recorder. This data is recorded manually on the switching sheets referred to above. Restoration times are recorded manually.

For low voltage, in the Sydney region, field staff are required to be in communication with the Network Controller whenever the network is switched and control staff are required to document switching as it occurs.

In the Newcastle region, field staff do not communicate with the Network Controller except where the outage involves the substation. Accordingly, no record is kept of low voltage interruptions other than substation incidents.

The start time for the outage is recorded as either the time of the customer call via the Call Centre or the time recorded by the event recorder of the SCADA system.

Temporary interruptions and restorations that occur during fault isolation and restoration are recorded against the initial incident.

Checks on the accuracy of reporting of interruption and restoration times are covered by the overall quality assurance process of the organisation. Except for the internal audit review referred to above, no further checks are undertaken.

Potential inaccuracies in the unplanned outage figures arise from:

- Not all single customer outages being recorded
- Inaccurate reporting or recording of times by either field crew or system control staff
- Inaccurate data entry from log sheets
- Inaccuracies in the recording of the network affected by abnormal switching conditions
- During storms (busy time in the Control room) the duration is sometimes estimated, as the actual is not known.

6.3.5 Handling of Staged Restorations

With staged restoration, a record is kept of each stage of restoration and included in the FODS. The number of customers is determined automatically by the number of customers allocated to the substation. Accordingly, as long as the staging is accurately recorded on the log sheets, the number of customers affected is derived from this estimate.

The timing of the intermediate stages of the restoration are based on reported switching times from the field operators and are recorded on the log sheets by the system controller.

Extensive use of mobile generation is utilised to limit outages in the Sydney metro region. Many substations are configured with lugs to accept connection of generators. In the Newcastle region only limited use is made of mobile generation.

Restoration of supply is considered complete when the customer is able to utilise the electricity no matter from what source it is supplied. At the time of disconnecting the alternate supply, an interruption report is produced in those circumstances where the alternate source cannot run in parallel with the mains supply.

6.3.6 Incident Causes

EnergyAustralia advised that incident causes are categorised in accordance with what was stated to be ESAA cause categories. These are detailed in a listing of cause categories in the case of the Sydney region, and by way of drop-down menus in the case of the NAC system for the Hunter region. Copies of relevant schedules were sighted[29]. Six upper level cause descriptions are utilised as follows:

- Overview codes:
  - Equipment
  - Weather
  - Environment
  - Human
  - General
  - Planned

Each of the overview codes is divided into a further set of ESAA subcategories resulting in 29 subcategories. These subcategories are utilised by the Newcastle region as the lowest level of recording of interruption cause. In the case of the Sydney region, the 29 ESAA subcategories are subdivided into a comprehensive range of cause codes that can be mapped against the ESAA subcategories. Many of these subcategories have been

[29] PB Associates Document Reference: EA158099B #9

introduced in order to respond to specific questions that have been raised from time to time. Although all cause codes are mapped into the 29 ESAA subcategories, the cause codes for the Hunter region and Sydney region do not actually overlap.

All data associated with the outage is entered into the FODS database by a small group of technical staff in the Sydney region and by the system operators in the Newcastle region.

There is no provision for inclusion of any secondary causes and effects associated with the outage. Secondary causes can be entered through associated reports, but are not generally used. For major incidents comprehensive reports are prepared on cause, effect, incident management and any notable circumstances. However, these are not incorporated into the FODS system.

As is the case for most of the system, little formal documentation exists with respect to the process. A high level of reliance is placed on the skills of the limited number of personnel involved in the process. Nevertheless, the level of consistency of coding of the causes due to the details recorded by the network controller, the variety of ways of interpreting the cause descriptor and the cause itself makes it likely to have an impact on the quality and consistency of cause information. However PB Associates has determined that the data issue will have little or no impact upon the primary SAIDI, SAIFI and CAIDI data.

Age and wear evaluation is not a primary focus of the fault reporting system. Although mechanical failure is a recordable cause, EnergyAustralia state that maintenance assessment is separate to the reliability recording system and considers such asset performance indicators. PB Associates considers that this is a more general issue. Although it is felt to be outside the scope of this investigation it is an issue that will need to be addressed with respect to overall asset management strategies.

EnergyAustralia cause codes include "Cause not ascertained" for the Sydney region and "No cause found" for the Hunter region. For a sample 2 year period, these represented 26% and 25% of all incidents. Currently the system only allows the cause to be stated at the time of the incident. Outage reports are left open for specialist staff to add information as it becomes available. However, the original report is not currently updated to change the cause of the incident that is originally recorded in the system.

Weather conditions are recorded separately to the cause code. Different categories for weather conditions exist between the Sydney region and Newcastle region at the time of coding. When the weather conditions are categorised as "Major Storm", all incidents covered by this classification are excluded from the performance indices.

The determination of a major storm (severe weather) is stated to be defined in accordance with the MEU definition. The definition has been expanded by EnergyAustralia to also include when a state government declaration is made or where additional resources need to be brought in to handle the event. Examples of this include bringing in staff from other regions or from other utilities.

Although weather conditions are recorded separately to the cause code, a number of the causes themselves are weather related. For example: wind; flood or cyclone; lightning or electrical storms are defined cause codes, in addition to any statements on weather.

All momentary interruptions, irrespective of whether they are a few seconds or up to a minute are logged as 1-minute interruptions. This is largely driven by the fact that the database will only accept an integer of minutes. This has a negligible impact on the SAIDI, SAIFI and CAIDI indices.

Where multiple operations occur of reclosers occur, separate 1-minute interruptions are not logged, but rather treated as a multiple of minutes equal to the number of operations.

This is particularly so for manually read cyclometers on reclosers where a record is kept of the previous cyclometer reading. As this becomes recorded as an interruption greater than one minute, the number of interruptions greater than 1 minute is slightly overstated. However, PB Associates considered that the error is not material.

Data is collected in relation to directed load shedding and generator / transmission failures. However, for the purpose of reporting indices these events are excluded.

Plant and circuit data for the network consists of TIS and a subset of TIS referred to as FODS for the Sydney region. For the Hunter region, the NCA is used, but populated with data that is in TIS. For the Sydney region circuit data in terms of connectivity between substations and switches is in the TIS system. However, line lengths and line characteristics are not available.

6.3.7 Treatment of Data

The treatment of storm related incidents has been detailed previously in section 6.2.1. Other incident causes that may result in special treatment of data are TransGrid directed load shedding and generation incidents. Directed load shedding, which has not occurred in recent years, would be recorded as an unusual occurrence and thus is not included in the incident statistics.

EnergyAustralia advised that all transient interruptions are treated as 1-minute interruptions. EnergyAustralia further advised that internationally accepted definitions of SAIDI an SAIFI includes momentary interruptions and EnergyAustralia report in accordance with this definition, despite the definitions prescribed in SCNRRR.

Recloser operations in the field, which are not subject to SCADA monitoring, are not recorded in relation to events but only in aggregate numbers without reference to the time period.

Repeated interruptions are recorded in the system as linked events. A second event is only recorded where there has been sustained restoration of supply.

EnergyAustralia advise that all transients are included if they are noticeable (ie. within the technical parameters of the Power Quality Meters). This is discussed further below.

EnergyAustralia has raised a number of issues associated with the SCNRRR requirements.

- EnergyAustralia does not include unmetered supplies in the count of customers for the purpose of reliability monitoring.

- Severe weather events are excluded by referring to the MEU's suggested approach. However, EnergyAustralia does not accept the appropriateness of the 3-minute rule approach for determining whether an extreme weather event should be excluded. EnergyAustralia suggest an approach utilising a statistical methodology to exclude events that are demonstrably outside normal conditions. This could for example, be any event that results in a SAIDI that is not within 2 standard deviations of the mean SAIDI.

- In the absence of direct customer connectivity, EnergyAustralia believe that the current level of reporting utilising postcodes provides reasonably accurate data of the impact on the broad SCNRR customer categorisation. The errors associated with small areas of outage are not considered to be material. However, in the CBD network, the SAIDI and SAIFI indices rely on customer numbers. The size and importance of users in a CBD may vary widely. EnergyAustralia believe that basing reliability on the number of customers may not give a good indication of the impact of CBD outages on customers. Utilising the NMI or active account, a large building, shopping centre of factory may only have one NMI. Yet the impact on the large number of people within the complex could be extreme. EnergyAustralia suggest consideration of the adoption of the Regulatory test.

The current system of reporting has been in place since 1988 in the Sydney Metro area. In the Newcastle area, accessible historical data is available up to 1990, although linkage to customers was not established until 1994.

During the previous 5 years, both the Sydney region and the Newcastle region have not altered their methodologies of reliability reporting. However, it is intended to integrate the data in the near future into a common database and data-warehouse. For regulatory reporting, the Network Reporting database has been used commonly since 1994/95.

Stored data is partly in a mainframe computer system and partly in a PC based database on a DB2 format. SQL and SAS query languages are used to extract the data. Any of the output data can be placed in Excel format.

A key factor in the computation of the SAIDI, SAIFI, and CAIDI indices for CBD, Urban, Rural short and Rural long feeders relates to the queries that are run against a database or data-warehouse. It is very much a function of the detail of the script that is prepared as to what data is extracted. PB Associates consider that it will be necessary to carefully audit the actual data and scripts that are used for the extraction of the data. In this regard, check sums strategies need to be considered to ensure that an adequate number of records have been accessed and that the extraction is comprehensive enough to capture all the data.

6.4 MOMENTARY INTERRUPTIONS AND POWER QUALITY

6.4.1 Power Quality

The principal document associated with power quality issues utilised by EnergyAustralia is ES2 Electricity Supply Standards [30] a copy of which was provided to PB Associates. As referred to earlier, this document, prepared in accordance with the Electricity Association of NSW Code of Practice – Electricity Supply Standards, sets out EnergyAustralia's objectives in terms network reliability. This document is also a descriptive account that sets out the issues associated with power quality. In this regard, it also sets out EnergyAustralia's objectives with respect to voltage levels, voltage dips, voltage balance and unbalance.

As a result of the recent publication on Power Quality by ESAA, EnergyAustralia is in the process of reviewing its ES2 document with a view to withdrawing the document and replacing it with a complementary document to that of the ESAA document.

The power quality monitoring process is a separate one to that of the network reliability monitoring and is handled by the various district offices of EnergyAustralia under the overall Customer Care framework.

PB Associates were provided with a copy of the document setting out the procedure for handling complaints/disputes (Customer Complaint/Dispute Management Procedure (EAC-CC&DP001)[31] issued by the Manager Compliance & Management Systems.

In the definitions of this document, an "enquiry/'request for service'" is defined as the initial contact of an EnergyAustralia customer raising an issue, whether that is a question, notification or a report. This includes such matters as: loss of supply; street light outage; high bill; damage claim; incorrect address; or late appointment. A "complaint" is any expression of dissatisfaction with a product or service.

An enquiry becomes a complaint when the customer is not satisfied with the response to their enquiry and wishes to raise a complaint to a higher level within EnergyAustralia. Also an enquiry is escalated to a complaint if the customer notifies EnergyAustralia that their issue has not been responded to and 21 days has elapsed since the initial contact of that issue. A "dispute" is a pursued unsatisfied complaint.

[30] PB Associates Document register reference EA158099B #1
[31] PB Associates Document register reference EA158099B #31

All enquiries/requests for service are managed through the Customer Care System (CCS). The Call Centre receives the first call from a customer and, in conjunction with the assistance of the CASS system an assessment is made as to whether the call is an administrative/accounts call, an individual service call or a network problem. Matters referred from Ministerial, Ombudsman, MPs, etc are also logged into this system. In the case of individual service calls or calls related to the power quality, the call is referred to an EmSO to attend and assess the matter.

On attending the site, if the EmSO determines that this is a matter that needs further attention/investigation, the call is logged in the CCS as a complaint and referred to the appropriate Region/ District office. At that stage, the call is categorised as to the nature of the complaint. As the classifying person is a non-technical person, the complaint is logged as a voltage complaint, irrespective of the detail of the nature of the technical problem.

At the District Office, various systems/subsystems are in place to handle the call and inquiry. However, in general, the call is referred to a local technical officer in the network planning area to initiate the necessary process to undertake further investigations. As a result of the investigations, an assessment is carried out as to whether the complaint is valid and as to the works required to remedy the problem. Works orders are initiated to carry out the remedial work.

Should the assessment find that the problem is a major network issue on the high voltage network, or should there be any technical challenges, the matter is referred to planning group at head office for assessment and initiation of corrective action.

Some districts have supplementary databases that track all complaints. Others manage the process by maintaining job files and personal diaries.

No categorisation process was identified in terms of the various SCNRRR categories of voltage / power quality complaints.

Monthly reports are prepared for management to monitor the number of voltage complaints. The total number of voltage complaints received in a year is subject to performance targets for each region. A copy of relevant reports were sighted at the Hunter district office at Wallsend and at the Sydney North district office at Hornsby[32].

6.4.2 Momentary interruptions

All recordable momentary power interruptions are recorded in FODS as 1-minute interruptions. This process is fairly complete in the Sydney region. In the Newcastle region, multiple recloser operations are recorded as a multiple of the number of operations - each one-minute. This results in a slight overstatement of interruptions, and would result in some successful reclosures not being identified as momentary interruptions.

Cyclometer readings associated with non-automated reclosers are routinely collected and entered into FODS as 1-minute interruptions.

Assessment of MAIFI has not been undertaken as part of any formal monitoring process within EnergyAustralia although the necessary formal monitoring systems are in place.

In the Newcastle region, the population of reclosers is approximately 150. Of these, approximately 70 have had communications facilities installed to link with the SCADA systems to facilitate monitoring of the operation of the reclosers. EnergyAustralia is moving in the direction of completing the installation of SCADA systems for all reclosers over the next few years.

In addition, EnergyAustralia is presently trialling a Distribution Automation System with a view to facilitating a substantial improvement of the performance indices. This project

[32] PB Associates Document Reference: EA158099B #24, 32-36

proposes extensive use of unit protection on the 11kV system, together with the extensive use of reclosers.

With respect to monitoring, initially, as a result of the Olympics project, EnergyAustralia installed a number of power quality meters in the Homebush Bay and surrounding areas. Six Power Measurement PQ meters are now installed (4 being Power Measurements PM 7700 and 2 being PM7600 models). Permanent meters are now installed at the following 6 locations:

- 2 on the 415V network (132kV CBD location and 1 at Olympic Stadium) (although these units are installed on the 415V network, they are located such at locations closely coupled to the 132kV network and little low voltage load)
- 1 on the Homebush Bay 11kV network
- 2 on the 33kV system (1 at Strathfield and 1 at Kooragang Island Newcastle)
- 1 on the 66kV system at Singleton.

All of these meters are monitored remotely from head office. A complete database log of the historical record of power quality at these points is maintained.

EnergyAustralia commented that with this limited number of meters, a good understanding could be obtained of the performance of the whole network. EnergyAustralia are proposing to increase the number of permanently installed meters to get complete coverage of the 132kV network. A total of 25 PQ meters are planned to be purchased in 2002/03. These meters will be installed near major customers in order to improve EnergyAustralia's ability to deal with any contractual issues associated with major customers.

EnergyAustralia categorise transients as follows:

- Transients defined as occurrences in the range of 156µs – 20ms
- Sags/Swells are defined as occurrences > 20 ms.

The various installed PQ meters measure transients and voltage dips.

At this stage, no PQ metering is installed at reclosers. However, it is proposed to utilise the PQ functions that are now available in smart revenue meters to extend monitoring.

EnergyAustralia is working with the University of Wollongong as part of the new PQ (voltage sag) monitoring program. This program aims to undertake long term monitoring of a significant number of sites within EnergyAustralia to monitor voltage sags and dips, as well as some of the other basic PQ data. Smart revenue metering sites are being proposed as sites for capture of PQ data. It is expected that 70 sites will be monitored.

6.5 REPORTING OPTIONS

6.5.1 Historical Data

The EnergyAustralia reliability reporting systems are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

PB Associates considers that the EnergyAustralia systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information is available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information should also be available for both planned and unplanned outages.

The historical EnergyAustralia reliability data is not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates consider that it would not be possible to accurately determine this information from the existing systems.

The present day collection of MAIFI data is most complete across EnergyAustralia. Based on this, PB Associates considers that the provision of historical MAIFI data would possible. However we note that this level of MAIFI information is not available across the other DNSPs.

The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

6.5.2 Energy not Delivered

"MVA hours lost" is not a parameter that is captured or monitored by the EnergyAustralia process. However, as the NRD database is a comprehensive repository of all events that have occurred for all distribution centres within the EnergyAustralia area over many years, a variety of structured queries can be undertaken. However, it is understood that no historical record is maintained with respect to network connectivity. A historical record is retained of the number of customers supplied per distribution circuit. The loading of distribution centres and load profiles based on time of day / time of year basis are not readily available.

Accordingly, any attempt to determine energy not delivered would be highly subjective.

Monitoring of energy not delivered is not part of EnergyAustralia's DNMS system.

6.5.3 Faults per Kilometre

Once details of feeder and feeder section lengths are finalised at the end of 2002, computation of the failure rate of sections of the feeder can be readily determined from the NRD database. The reporting of this information will require development and audit of the relevant queries that have been written to interrogate the database.

6.6 SUMMARY

EnergyAustralia has a comprehensive database of low voltage distributor circuit abnormalities. The database maintains a longstanding history of the disturbances that have occurred on a particular distribution centre.

Due to the fact that EnergyAustralia does not have readily identifiable records linking the customer to the network, either through the use of NMIs or any other method, EnergyAustralia has developed its own methodology by averaging the number of customers per distribution circuit based on the number of customers and distributors in a postcode area.

This method can result in large errors in the computation of the reliability factors when considering areas smaller than the postcode area. The errors are such that when an overstatement occurs on one feeder, an understatement occurs on another. However, if particular performance figures are being targeted at a feeder level, this will remain a source of inaccuracy until an actual linkage is established between the customer and the network.

The overall system consolidated reliability factors are considered to be reasonably accurate.

PB Associates has identified a number of areas where the current systems and processes result in errors in the computation of the reliability factors.

It is important to note that the estimated impact figures provided below are highly qualitative in nature due to the lack of historical and supporting data. It is also not possible to summate the estimated impact figures, as there are interrelations between each factor.

Potential sources of Data Inaccuracy	**Estimated Impact (Sydney region)**[33]	**Estimated Impact (Newcastle region)**[34]	**Estimated Impact EnergyAustralia**[35]
New customers not allocated to Distribution Substations		-5% to +5%	-1% to +1%
Customers allocated to distribution circuits by postcodes	-25% to +%25%**		-5% to +5%**
LV single premises outages not captured	+1%	+2% to +7%	1.2% to 2%
Base-load outages allocated to Storm	+0% to +2%	0% to +2%	0% to +2%
LV Circuit allocations	0%	-3% to +3%	-0.5% to 0.5%
Phase allocation	-2% to +2%	-2% to +2%	-2% to +2%
Outages by ASP's	0% to +1%	0% to +1%	0% to +1%
Overall estimate of reliability data Inaccuracy			**-10% to +10%**

** Note: The variation on an individual feeder basis can be very large (excess of 60%).

Table 6-1

EnergyAustralia is currently in the process of completing the implementation of a new GIS system and is at factory testing stages of a Distributed Network Management System. A plan is presently being formulated for the establishment of a new IT&T Strategy. The present capital expenditure with respect to network related IT&T over the period 2002/03 to 2005/06 is $26M. It is expected that the as a result of the IT&T Strategic Plan being developed, additional funds will be sought.

To improve reliability reporting accuracy in accordance with SCNRRR it will be necessary for EnergyAustralia to establish a linkage between the NIM and the network. EnergyAustralia indicate that once the GIS project is completed this is a project that may be able to be expedited.

[33] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

[34] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

[35] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

As the detailed specifications and documentation for the proposed systems are not presently available, it is not possible to quantify the exact improvements that these new systems will have on reliability reporting.

PB Associates estimate that an indicative cost of the data capture exercise to establish the linkage could be in the range $4M to $5M. In addition, there would be data system costs to modify existing systems, which could be up to $1M.

7. COUNTRY ENERGY

7.1 OVERVIEW

Country Energy was formed in 2001 as a result of a merger of three former NSW electricity distributors: Advance Energy, Great Southern Energy and NorthPower. Due to its recent formation it has three corporate head offices in Bathurst (former Advance Energy - Central), Queanbeyan (former Great Southern Energy - South), and Port Macquarie (former NorthPower - North), and still maintains three distinct systems for capturing customer supply interruption data in each of the former regions. Country Energy distributes electricity across the majority of regional NSW, and therefore, has a predominantly rural and sparse customer base.

PB Associates representatives visited Country Energy over a 5 day period, visiting offices and control rooms in Port Macquarie, Bathurst, Queanbeyan, and Cooma. The purpose of these visits was to review the reliability reporting processes and interview relevant Country Energy staff. During the visits a meeting was held with the former duty officer of the Muruya control room[36] and a telephone conference was held with the duty officer of the Wagga Wagga control room[37].

Prior to the visit, PB Associates was provided with a partially completed copy of the Country Energy questionnaire. The answers provided related mainly to the former NorthPower region. It is important to note that Country Energy were the first NSW distributor to be reviewed and as such had very little time to complete the questionnaire, PB Associates acknowledge the effort of Country Energy to provide partial answers prior to our visit in the time available.

To give comparison consistency between distributors, the questionnaire was completed by the PB Associates representatives, based upon information provided, demonstration given, and interviews held with Country Energy during the visit.

PB Associates notes the open access that was provided to Country Energy staff and documentation.

Information Systems

Country Energy presently has three distinct systems for monitoring, capturing and reporting network reliability information relating to the three former company regions. The main components in the existing systems in the three former regions are summarised below:

North:

- NIBS – Customer Information System and call centre fault recording system.
- SmallWorld GIS system.
- MITS Mosaic – prime SCADA system. Also a number of legacy systems currently being phased out. Generally, SCADA is present down to zone substation HV feeder circuit breakers.

[36] The original scope included a visit the Muruya control room, however, the Country Energy employee responsible for the customer interruption database at this location had recently been transferred to the Queanbeyan office. It was therefore considered more useful to interview this employee at Queanbeyan.

[37] The original scope included a visit to the Wagga Wagga control room. Due to time constraints the visit to Wagga was not considered appropriate. A visit to a control room at Cooma, similar in nature to Wagga was undertaken. A telephone conference with the duty officer of Wagga was held at the Cooma control centre.

- FAST – Field Automated Service-order Tracking system. FAST is a newly developed electronic system that communicates with remote mobile field crews. The system allows Country Energy to dispatch work centrally to appropriate scheduled and emergency field crews.

- DAMS – Distribution Asset Management System. DAMS is used as the customer interruption recording database which records the incident and customer interruption information that is required to produce the reliability reports.

- LV interruption databases – Country Energy are presently developing two LV interruption databases to record LV incidents. Although Country Energy have not reported LV incidents prior to this date, they intend to report LV incidents from now.

Central:

- ENERGY – Customer Information System.

- SmallWorld GIS system.

- iFIX – SCADA system. Generally, SCADA down to zone substation HV feeder circuit breaker.

- K&M – the customer interruption recording database which records the incident and customer interruption information that is required to produce the reliability reports.

It is the intention of Country Energy to implement the FAST system in the Central region by November 2002. The initial fault call will then by recorded in ENERGY and transferred to FAST and on to K&M to initiate an incident record.

South:

- GSECIS – Customer Information System and call centre fault recording system.

- FAST – Field Automated Service-order Tracking system. FAST is a newly developed electronic system that communicates with remote mobile field crews. The system allows Country Energy to dispatch work centrally to appropriate scheduled and emergency field crews.

- PowerView GIS system.

- ENMAC – SCADA system. In process of being installed to replace a number of legacy systems. Generally, SCADA down to zone substation HV feeder circuit breaker.

- END – Energy Network Database. The customer interruption recording database which records the incident and customer interruption information that is required to produce the reliability reports.

It is the intention of Country Energy to consolidate the System Operations to the Queanbeyan OSC. The input into END will then be centralised and performed by network in Queanbeyan. This consolidation is due to begin in October 2002 and be completed by June 2003.

For all the above interruption databases, additional reliability reporting tool are used to generate particular reliability reports in each region. To further rationalise this process, Country Energy are producing database utilities to export the NP and AE database records to an END formats such that the Country Energy reliability reports can be produce from one centralised source. It is important to note that this is only for output reporting, data input will still be in the original database. The porting utility is expected to be completed in November 2002.

Future Information System Works

Country Energy is presently planning to adopt a Virtual Operations Service Centre (VOSC) across its whole system. This system will be supported by a new Distribution Management System (DMS).

Country Energy have stated the following in their Business case with respect to the VOSC/DMS project.

"*The implementation of the Virtual Operations Service Centre (VOSC) supported by a Distribution Management System (DMS) will deliver key quantifiable and intangible benefits including:*

- *Accelerated development of a common culture – team based approach*
- *Improved customer service - matching resources to workload*
- *Economies of scale without centralisation - existing physical facilities become one virtual facility, maintaining a regional focus*
- *Flexibility of operations and resource optimisation - resourcing based on workload not geography*
- *Improved regulatory compliance - accurate, auditable reliability reporting*
- *Reduced operating costs - through efficiencies and economies of scale*
- *Cost effective and seamless disaster recovery - automatic and permanently available due to DMS*

The implementation of VOSC will be a fundamental and significant change program to deliver efficient and effective System Operations, Dispatch and Outage Management services to customers and staff

VOSC will comprise an integrated solution of process, information, applications and technical infrastructure

The primary applications underpinning the DMS are GE's SCADA, Network Management System and Trouble Call System integrated with Smallworld Geographic Information System (GIS)."

The information provided to PB Associates regarding the VOSC/DMS project indicates that, when complete, this project will greatly enhance the quality and accuracy of reliability information.

The VOSC/DMS project will provide Country Energy with the following reliability related modifications;

- Improved identification of customer numbers affected by faults,
- Improved linkages between customers and assets (at a lower level than the present Distribution Substation),
- Reduced manual intervention in reporting process – customer numbers and switching times generated automatically where SCADA exists,
- Improved reporting options,
- Improved tracking of faults,
- Improved identification of fault commencement and completion times,

- Simplified allocation of assets and faults to current SCNRRR definitions.

Country Energy have advise publicly[38] that the VOSC project is underway, indicating a 3 year project. The project business case provided to PB Associates during the course of our review indicates a 3 year project, due for completion in 2004/05. The total cost of the VOSC project is approximately $7 - $9 Million. It is difficult to estimate what proportion of this cost related directly to the outage monitoring, management and reporting functions.

7.2 POLICIES, SYSTEMS, PROCEDURES AND AUDIT

7.2.1 Network Reliability Reporting

IT Systems

Country Energy has three different outage recording and reporting database systems in use. The three systems are used in the regions covered by the three former companies that merged to form Country Energy.

In the North region, Distribution Asset Management System (DAMS) is used as the customer interruption recording database. This system only records incident information relating the Country Energy HV network and higher voltages (i.e. LV outages not recorded). DAMS is based upon an Oracle engine and was developed in-house in 1997. The incident records in DAMS are manually input from hard copy switching sheets produced by network controllers.

Country Energy are presently developing two LV interruption databases to supplement the DAMS database. These databases will record LV incidents in the North region. Although Country Energy has not reported LV incidents prior to this date, they intend to report LV incidents now. LV Fuses is an Access database that is used to records LV fuse blow incidents at distribution substation. This database will be input by those staff responsible for DAMS input. Other LV incidents are recorded by dispatch on an Excel spreadsheet database. Country Energy have not set any rules or guidelines as yet detailing the population of these LV databases, particular with respect to the estimation of customer numbers effected.

In the Central region, K&M[39] is used as the customer interruption recording database. K&M is based upon an Infomix engine and was developed in-house prior to July 1995. An incident record is initiated due to a customer call and certain fields automatically input. The remaining fields are input by network controllers within the coordinating control room as network switching occurs. Records can also by initiated by operators for planned incidents and incidents recorded by the SCADA systems. The K&M database records all fault incidents and has standards reporting outputs.

In the South region, Energy Network Database (END) is used as the customer interruption recording database. END is based upon an Oracle engine and was developed in-house in 1999. The interruption facility of END is manually input from hard copy switching sheets. These sheets are produced by either the duty officers or field staff in different regions. The form is not standard throughout the South region. The END database records all incidents and has standard reporting outputs.

The input into END is planned to be centralised and performed by network operators in Queanbeyan following the consolidation of System Operations to Queanbeyan. This will be a staged transfer as local control rooms transfer operations to Queanbeyan. This transfer is planned to start in October 2002 and be completed by June 2003.

For all the above interruption databases, additional reliability reporting tools are used to generate particular reliability reports in each region. To further rationalise this process,

[38] Media Release 19/8/02

[39] The acronym K&M is derived from the names of the two people within the former AE who were responsible for the core development of the application.

Country Energy are producing utilities to export the DAMS and K&M database records to an END formats such that the Country Energy reliability reports can be produce from one centralised source. It is important to note that this is only for output reporting, data input will still be in the original database. The porting utility is expected to be completed in November 2002.

The input of data into the various databases is a highly manual. Country Energy do not have any procedures or formal guidance related to the use of any of the databases.

Human Input

The human involvement in outage incident data collection, database population and reliability reporting is relatively high for both planned and unplanned outages.

For unplanned outages, customer interruption incidents are notified through the Country Energy Call Centres or recognized directly via the SCADA system (for High Voltage feeder faults and above). A system dispatcher then assigns the call to a fault attendee or network operator who is then responsible for the initial attendance and assessment.

If asset replacement or repair is required to rectify a fault, the fault attendee refers the call to the local depot. If no replacements or repairs are required, an operator or fault attendee undertakes inspection and restoration.

Information relating to the fault, in terms of cause, effect and switching times is relayed back for database input in a number of ways, depending on the region.

In the North, the network controllers fills out hard copy emergency switching sheets based upon information communicated back to them from the field staff. These switching sheets form the basis for producing the records in the reliability database.

In the Central region, network controllers fill out the incident database record directly based upon information communicated to them from the field.

In the Southern region, in certain areas, the field staff are responsible for filling out a hard copy switching sheets. In other areas, the duty officers fill in a hard copy switching sheet based upon information communicated to them by the field staff. The switching sheets are then used to produce the records in the reliability database. The transfer of information from these hard copy sheets to the database may be a number of days following the production of the switching sheet.

For planned incidents a similar process is used in each region as described above based upon planned switching sheets

The general level of training/qualifications for those involved in the fault reporting process is described below;

- **Fault attendees -** qualified line/electrical tradesman.
- **Dispatch Staff -** qualified electrical mechanics with tertiary education and process training.
- **Network Operators -** qualified electrical mechanics with tertiary education and process training.
- **Data Collectors/Input -** consist mainly of the above group of personnel.

Weather Related Data

Country Energy captures weather conditions for all unplanned incidents. Incidents related to "Severe weather" are flagged within the databases such that customer minutes and interruptions related to such incidents can be extracted for reporting.

Country Energy define "severe weather" based upon severe weather days published on the Bureau of Meteorology Website. The local operator decides at the time of record input whether or not they considered the fault incident to be due to the severe weather event.

The present use of the "sever weather" definition is not in line with the SCNNR definition of "excluded events" i.e. exceptional natural or third party events that result in an overall SAIDI impact of 3 minutes.

Country Energy have raised concerns about the 3 minute SAIDI impact as due to their predominantly sparse rural and radial network, event severe weather incidents may not be wide spread enough to impact SAIDI by more than 3 minutes. However, the localised impact may well result in Country Energy being unable to manage the situation efficiently.

Country Energy has encounter about 5, 23 and 5 severe weather days in the last 3 years. This amounts to around 11, 70, and 3 minutes of SAIDI respectively.

7.2.2 Network Performance Improvements

Reliability Measurement Improvements

The most significant improvement planned by Country Energy is the VOSC and DMS project that is described in the Overview section 7.1 of this report. Part of this project is the consolidation of the Southern region to a single system operation in Queanbeyan, which should result in much improved reliability database input. This initial phase is due to begin in October 2002 and be completed by June 2003. The accuracy of reliability reporting in the South should improve in step changes as the local depots cede operational control to the new Queanbeyan control room.

During the course of the main VOSC project, Country Energy has a number of other projects to improve reliability measurement and reporting. Examples of these are: the rationalisation of all three reliability databases to one format for output reporting and analysis, and a programme to assign customer numbers to distribution substations within the GIS system to allow improved counting of customer numbers on HV feeders.

Reliability Improvements

Each of Country Energy's eight regions has a designated Regional Planner monitoring feeder reliability and recommending necessary improvement strategies for each individual region. A centralised Network Performance and Reliability Group supporting Regional Planners, monitor feeder reliability and improvement across the business.

Country Energy report on the specific poorest reliability feeders, the main causes of their unreliability, and specific project planned or underway to improve the reliability.

7.2.3 Audit Reports

PB Associates was provided with copies of an independent appraisal of the License Compliance and Network Management Reports for the three former companies. These reports are relatively short document and deal with all issues with respect to License compliance reporting, including reliability reporting. The appraisal appears to have involved an audit of the calculation of the reliability indices reported, including the database information and sources.

The following are salient extracts in the appraisal reports:

NorthPower 2000/01.

Number of customers - "The CIS system is regarded as being satisfactorily robust with franchise and tariff customer counts being accurate and complete. Customers for network only have had to be added in to the CIS" – Grade A

Distribution Reliability – "Customer numbers are estimated using standard algorithm. Not all incidents are entered into the recording system for use in this report and management reporting. These have not been considered significant and here have been improvements in recording introduced through the year" – Grade B

The appraiser's comments above about incidents not recorded relates to LV incidents. Country Energy advise that the non reporting of LV incident in the North represent an under stating of total SAIDI of about 2 to 4 minutes. Country Energy are now introducing databases to capture LV incidents in the North region.

Advance Energy 2000/01.

Distribution Reliability – SAIDI, SAIFI, CAIDI - Grade A

Great Southern Energy 2000/01

Number of customers - "The CIS system is regarded as being satisfactorily robust with franchise and tariff customer counts being accurate and complete. Customers for network only have had to be added in to the CIS" – Grade A

Distribution Reliability – "An audit of the worksheets prepared against the outages in the database found that 44% of forms were not entered. There were some valid reasons for this, but one disturbing reason was the failure of staff to return the paperwork. The outage system was improved with the introduction in February 2001, of mandatory rules being applied to a number of critical fields" – Grade C

Problem areas or feeders – "…There is a problem with depot completion of outage reports with correct data. The feeder statistics are incorrect because of the decision to take the highest number of customers affected." – Grade C

PB Associates questioned Country Energy further on the appraiser's concerns summarised above. With respect to the 44% of forms not entered, Country Energy stated that this related to a 44 % difference between Call centre logs relating to customer loss of supply and outage database record. Country Energy considered that the majority of these incidents related to LV types faults of which a significant portion were the result of faulty customer premise equipment and as such should not be part of the reported statistics.

With respect to the completion of outage reports with correct data issue, Country Energy accepted that this is a problem of varying degrees of significance in a number of depots in the Southern region. The key factor in this issue relates to depots where field staff are responsible for the completion of outage report forms.

It is impossible to gauge to exact scale of these issues on the accuracy of the SAIDI figure, without performing a comprehensive audit of the reliability database, which is not considered part of this scope of work. Country Energy have estimated the effect of this to be an under reporting of SAIDI in the South of about 10-20 % equating to an under reporting of total Country Energy SAIDI of around 4 to 8 minutes.

The consolidation of system operations and dispatch, and the introduction of the FAST system, should improve the performance and recording of outage incidents greatly in the Southern region. This should bring the accuracy of the reliability database in the Southern region more in line with those in the Central and North regions.

With respect to the Appraiser's comment relating to feeder statistics being incorrect due to the use of highest number of customer affected, Country Energy have advised that this is known problem for the reporting of feeder level SAIDI figures in terms of "worst feeder" reporting. These feeders were manually corrected for reporting. This problem does not affect reporting of total SAIDI.

7.3 DATA RELATING TO CUSTOMER INTERRUPTIONS AND DURATION

7.3.1 Customer numbers

Each group currently uses a different customer information system, and customer numbers are extracted from each and combined to form a total customer number for Country Energy. Vacant accounts are extracted prior to coming up with the total, however in past years it is possible that vacant accounts were included in total customer numbers used for calculating reliability.

Country Energy counts total "customers" based upon counts of NMI (National Metering Identifier) within their CIS systems. Each service has a NMI associated with it. Unmetered supplies such as Traffic Lights/Telephone Boxes/bus shelters/Streetlights are grouped by a Transmission Node Identifier (TNI) and assigned to a NMI associated with the TNI. The inclusion of streetlight associated NMIs within the customer count is not in line with SCNNR where unmetered streetlights must be excluded. This small increase in customer numbers due to unmetered streetlights group to the TNI, totalling 350 additional customers, should have a negligible impact on reported SAIDI. It should however be a simple process to count the customer numbers associated with streetlights and subtract this from total customer numbers in the future.

Vacant accounts are extracted prior to coming up with the total customer number. Country Energy have advised that vacant accounts have been included in total customer numbers in previous reliability reporting. Country Energy have advised that this would have inflated customer numbers by approximately 6.5 % for previously reported reliability indices.

At this stage there is no link between the customer details in the CIS and the new feeder categories, CBD, Urban, Rural Short and Rural Long. As such there is no easy method of counting total customer numbers for the feeder categories in the CIS. The present system of counting total customers is based upon tariff type. Country Energy are presently in the process of linking all service accounts to a distribution substation in the GIS. This should allow the total number of customers associated with a feeder type to be estimated using an algorithm in the GIS system. Presently, in the north 70% of customers are linked in CIS and 58% are linked in GIS. In the central area 70% are linked in CIS and 10% are linked in GIS. In the south, only 3% are linked in CIS and none are linked in GIS.

7.3.2 Measuring number of customers affected

Country Energy has different methods of estimating customers affected in the different regions of the business. All methods are manual and result in an estimate of the number of customers affected, rather than an manual or automatic count of the actual number based upon the current customer databases.

The following is a discussion of the methods of estimating customer numbers in the various regions of Country Energy based upon discussion and demonstration held during the visits to various control rooms of Country Energy.

North – Port Macquarie

For LV incidents the database is being constructed and rules for estimating customer numbers have not been set. The probable method will be an estimate based upon affected distribution KVA for distribution substation fuse faults and a direct estimate of customers affected based up system knowledge for other LV faults.

DAMS records interrupted connected distribution transformer rated kVA and not the customers affected. The interrupted connected KVA is calculated by cross referencing hard copy schematics in the control room that have the connected kVA marked up with the opening or closing switches detailed on the hard copy switching sheet.

The actual number of customers affected is estimated in the reliability reporting spreadsheets.

The method used to calculate customer affected is as follows:

For incidents interrupting customers on HV feeders defined as urban, the customer number affected is calculated as interrupted connected kVA divided by 4 kVA per customer.

For incidents interrupting customers on feeders defined as rural, the customer number affected is calculated as Interrupted connected kVA divided by the total HV feeder connected distribution transformer kVA multiplied by the number of distribution transformers on the HV feeder (i.e. 1 customer per connect transformer).

All HV feeders are categorised as urban or rural based upon the majority of customer connected. The DAMS record holds the affected HV feeder reference such that the correct customers affected calculation can be performed.

For incidents that occur in the sub-transmission or above, multiple incident records are generated for each HV feeder affected.

Country Energy have not been able to provide any evidence to justify the 4 kVA per customer in urban areas and 1 to 1 relationship in rural areas other than to say it was based upon analysis performed a number of year ago.

For HV feeders defined as rural, it is clear that a 1 to 1 mapping of customer numbers to distribution transformer numbers must result in a minimum possible number of customers rather than an average, neglecting the affect of non active customers.

Based upon HV feeder information provided to PB Associates, a simple count of customer numbers based upon the above algorithm for all HV feeders in the North resulted in around a 20% under estimate in customer numbers. This may indicate a significant underestimation of customer numbers affected in the North, resulting in a possible underestimation of total Country Energy SAIDI of up to 10 %.

CENTRAL – Bathurst

For LV incidents the field crew report back on cause of outage and operations staff interrogate the CIS system ENERGY to determine likely customer numbers affected based upon the affected distribution substation and the fault clearance mechanism, and then manually enter this number into K&M system.

For HV incidents a number of methods are used depending on fault position: -

In Urban areas:

- Where there is SCADA on the Z/Sub then the load on the sub following the outage divided by 2.5kVA to give affected customer number.
- Where there is no SCADA, controllers ask the field crew for a reading of the load after restoration. This load is then divided by 2.5kVA to give affected customer number.
- For incident resulting in an outage of a distribution substation, affected customer number are extracted from CIS system ENERGY if information available (i.e. linkages between customers and distribution substation).
- For incident resulting in an outage of a distribution substation, if affected customer numbers are not available from ENERGY then the rating of the distribution transformer divided by 2.5kVA is applied.

In Rural areas:

- Affected customer number is estimated by counting the number of interrupted transformers on the operating diagrams and using a 1:1 ratio for the customer number estimate.

For incidents that occur in the sub-transmission system or above, total customers affected are counted based upon HV feeders or zones interrupted and a similar customer count method as discussed above.

Although the above rules appear similar to the North region it is important to note the salient differences:

- The Central area applies a 2.5 kVA of interrupted load per customer whereas the North applies a 4 kVA of interrupted distribution transformer rating per customer.

- The Central area categorise HV feeder segments to either urban or rural. The total HV feeder may be constructed from number of both urban and rural segments. The affected customer number rules adopted reflect the actual feeder segment affected. The North categorise the whole feeder as either urban or rural.

As Central categorise feeder segments as urban or rural rather than whole feeders, it would be expected that the 1 to 1 mapping for rural segments may be a closer approximation to rural customer numbers than that used in the North, although still a possible underestimate.

As the kVA per customer rule in urban areas is based upon load rather than connected kVA, the number of affected customers is a function of the time the incident occurs, and hence loads at that time. This may result in affected customer numbers being incorrect for individual incidents, however provided the kVA per customer factor is calculated correctly, the overall affected customer number throughout a suitable period should be reasonable.

Country Energy have not been able to provide any evidence to justify the 2.5 kVA per customer in urban areas and 1 to 1 relationship in rural areas other than to say it was based upon analysis performed a number of year ago. It is difficult to validate this based upon information provided by Country Energy during the course of this audit. PB Associates would recommend Country Energy provide validating documentation for these rules in order to gauge the materiality of the approximation. Assuming a similar error as in the North, this would result in an underestimation of total Country Energy SAIDI by approximately 3 %.

SOUTH

Moruya

Operating diagrams have been marked up by hand for customer number connected downstream from switches and subs. These are based on estimates and/or counts carried out some years ago which are updated by control centre staff in an ad hoc fashion as required based on their knowledge of developments in the network.

The affected customer numbers can be estimated by cross referencing customer numbers on the operating diagrams with the opening or closing switches detailed on the hard copy switching sheet.

Queanbeyan

A simple ad-hoc estimate based on network knowledge is made by the field crew or duty officer. In most cases these estimates are based on estimation and local knowledge, and due to time constraints on the data entry personnel, the accuracy of these estimates is not considered to be very high.

Wagga.

A combination of methods is used starting with a database showing the number of customers connected to each section of the network, however this database has not been updated for 10-15 years and the accuracy of figures especially in urban areas is doubtful.

The affected customer numbers can be estimated by cross referencing customer numbers in the database with the opening or closing switches detailed on the hard copy switching sheet.

Where the operator has local knowledge considered to be better than the database information this may be substituted when estimating customer numbers.

Cooma.

A system similar to Moruya is used involving marked up copies of schematics showing the names of each customer on the section of the network. However, many of these diagrams were dated 1993, 1995, etc and it is unclear when they were last updated, but some drawings showed hand marked changes.

The affected customer numbers can be estimated by cross referencing customer numbers on the schematics with the opening or closing switches detailed on the hard copy switching sheet.

It is impossible without performing a far more comprehensive audit to gauge the scale of inaccuracy in the affected customer counting applied in the South. We would not expect it to be any less accurate than the rule based approximations applied in the North and Central. It would be expected that assuming growth has occurred in the Southern network, then the lack of updating of customer numbers would result in an underestimate of affected customer numbers.

Adjustments to affected customer numbers

Where a staged restoration has occurred and these stages have been recorded on the log sheet, the calculation of the number of customers affected for each stage is calculated as described in the section above.

Country Energy did advise in various locations that where a number of stages may be close together a single most relevant stage may be entered into the database rather than individual stages. We would not expect this approximation to materially effect reliability figure.

Single Customer Outages

Single customer outages are not recorded in the North, although they will be in the future provided they are due to a network fault.

Single customer outages are recorded in the Central and Southern region provided they are due to a network fault.

It was also noted in the Cooma depot that hot water meter fault on customer own premises may sometimes be recorded. This has not been reported in any other area of Country Energy and as such we would consider this to have negligible impact on the total reliability indices reported by Country Energy.

System Abnormalities

Country Energy advise that system abnormalities (e.g. load transfers and switching) are taken into account when estimating customer numbers affected using the same methods as described above.

As this system relies on the operator to check for abnormalities and manually estimate customer numbers there is opportunity for errors to occur, however it is not possible to quantify these potential errors. Country Energy has advised that in their opinion there are very few occasions when this occurs. PB Associates would agree with this and consider that any potential inaccuracy would be immaterial.

7.3.3 Classification of Feeders

Country Energy is intending to use the feeder classifications as defined in the SCNRRR report.

In order to classify distribution feeder information the existing GIS systems in each region are to be used to automatically calculate route length. The GIS systems have been populated with HV feeder data from paper drawings and GPS. Country Energy have advised that in the North, the GIS has almost 100% of line length in the system, in the Central area the GIS has about 95 % in the system; and the South has about 99% in the system.

Overhead and underground line lengths will be extracted from the GIS in order to establish feeder classifications. The distances produced are feeder route lengths, not circuit lengths.

7.3.4 Restoration Times

The restoration times related to particular incidents that are input into the reliability databases in the three regions are obtained and input in the following ways:

NORTH

For fault incidents, the initial interruption time is recorded from the earlier of the time of the first customer fault call to the Call Centre or from SCADA if information is available. The initial interruption time and subsequent switching times are recorded on the hard copy switching sheet that is used as the base input for the DAMS record. This switching time information is recorded by control room staff from the information relayed back to them by field crews or taken directly from the SCADA system. A similar process using a planned switching sheet is used for planned incidents.

Actual switching times are recorded.

CENTRAL

For fault incidents, the initial interruption time is recorded from the earlier of the time of the first customer fault call to the Call Centre or from SCADA if information is available. The control centre log actual switching times into reliability database as the field crew advise, or times are taken directly from the SCADA system. A similar process is used for planned incidents.

Actual switching times are recorded.

SOUTH

For fault incidents, the initial interruption time is recorded from the earlier of the time of the first customer fault call to the Call Centre or from SCADA if information is available. The initial interruption time and subsequent switching times are recorded on the hard copy switching sheet that is used as the base input for the END record.

In some areas, this switching time information is recorded by control room staff from the information relayed back to them by field crews or taken directly from the SCADA system. In other areas, the switching sheet is filled in by the field staff. A similar process using a planned switching sheet is used for planned incidents.

Actual switching times are expected to be recorded.

It is clear from discussion with Country Energy personnel, particularly at Queanbeyan, that where responsibility for filling in the switching sheet is left to the field staff that approximate switching times or even no time at all may be recorded. It is difficult to estimate the scale of this other than to note that field crew entry occurs at a number of depots in the South region. Country Energy have estimated the effect of improper reporting in the South to be an under reporting of SAIDI in the South of about 10-20 % equating to an under reporting of total Country Energy unplanned SAIDI of around 4 to 8 minutes. The impending consolidation of system operations and dispatch in the South region should improve this situation, resulting in a process similar to that in the North.

7.3.5 Handling of Staged Restorations

The timing of intermediate stages of restoration are recorded as described in the above section.

Country Energy did advise in various locations that where a number of stages may be close together, a single most relevant stage may be entered into the database rather than individual stages. We would not expect this approximation to materially effect reliability figure.

7.3.6 Incident Causes

Country Energy provided PB Associates with detailed information relating to the classification of incident causes in their three reliability database systems. The following summarises these classifications:

North – DAMS

- Weather Condition
    - Fine conditions
    - Lightning/ storm
    - Flood
    - Not Applicable
    - Rain
    - Wind
    - Tempest
    - Snow/ sleet
- Interruption Cause
    - Accident Third party/ Vandalism
    - Capex
    - Corrosion
    - Customer Installation
    - Fauna - animals & birds
    - Fire
    - Failure or defect

  - Load shedding
  - Maintenance
  - Not applicable
  - No Cause Found
  - Operator/Staff Error
  - Overload
  - Pollution
  - Safety reasons
  - Transmission & Generation
  - Trees Blown into wires
  - Trees growing into wires
  - Weather
- Equipment Type
  - Subtransmission Line Breaker
  - Conductor down
  - Construct
  - Cross-arm
  - Insulators & Earthing
  - Fuse
  - Hardware & fittings
  - Lightning Arrestor
  - Not applicable
  - Overhead switch/ABS
  - Other
  - Pole
  - Customer's Service
  - Sectionaliser/ Recloser/ Circuit Breaker
  - Stay
  - Streetlight
  - Transformer/ Regulator
  - Underground cable

  - Underground joint/ termination
  - Zone Substation

Central – K&M

- Cause codes
  - Accident – incl. Cars Truck etc.
  - Birds/Rodents Animals etc
  - Trees/Vegetation - Norm. Conditions
  - Equipment Failure
  - Fire – bush/grass/house
  - Contact with HV & LV
  - Major Storm
  - Electrical Shock
  - Lighting/electrical storms
  - Mistake – by operating staff
  - Overload
  - Palnned Outage
  - Live Line work
  - Snow/sleet/blizzard
  - Transformer Problem
  - Unknown
  - Vandalism
  - Wind – including trees blown into mains
- Equipment Codes
  - Pole
  - Conductor
  - Crossarm
  - Insulator
  - Ties
  - Stay
  - Cable Termination
  - Underground Cable

- Service Pillar
- Circuit Breaker
- Recloser
- sectionaliser
- Fuse
- Air Break Switch
- Links
- surge Divertor (Lighting Arrestor)
- Live Line Connection
- Isolator (Magnetfix, etc)
- Link Pillar
- Distribution Transformer
- Current/Voltage Transformer
- Voltage Regulator
- Zone Transformer
- Street Light
- Street LightColumn
- PLC
- Revenue Meter
- FI Receiver

South – END

- Weather
  - Wind
  - Calm
  - Rain
  - Blizzard
  - Flood
  - Extreme Wind
  - Unknown
  - Electrical Storm
- Cause

- Equipment - Failure or Defect
- Lightning or Electrical Storms
- Wind - Including Wind Borne Materials
- Flood or Cyclone
- Snow, Sleet or Blizzard
- Tree Blown onto Mains
- No Cause Found (Storm Conditions
- Trees Growing into Mains
- Animals and Birds
- Corrosion
- Pollution
- Fire - Excluding Pole Top
- Vandalism
- Accidental (Vehicle, Plant etc)
- Customer Installation
- Operator or Staff Error
- Industrial Relations
- Safety Reasons
- Overload
- Due to Transmission & Generation System
- Load Shedding
- No Cause Found Not Storm Conditions)
- Other
- Planned Outage

- Main Equipment Groups
  - Overhead Mains'
  - Underground Mains
  - Switchgear
  - Transformers
  - Protection Equipment
  - Miscellaneous Equipment

Country Energy advised that there is no formal written guidance on the use of the "cause" categories. Country Energy considered the technical competence of the Country Energy personnel responsible for cause identification and logging is sufficient for accurate reporting.

Based upon our discussion with personnel we would consider this to be correct in general, particularly in the North and South. However, it was clear during the visit to Queanbeyan where it is the responsibility of field staff to log the cause that confusion can arise with respect to the fault cause and effected equipment, or even the fault clearance device. The consolidation of the system operations and dispatch in the South should improve this situation. Following this, the field crew will no longer be responsible for logging the fault information.

All three databases used by Country Energy record primary cause only. Faults due to equipment failure are defined as an explicit cause, however, the exact nature of the failure (e.g. age and wear, poor design, etc) are not recorded. DAMS and END both have weather defined as a separate field from the cause, K&M only defines weather within the cause categories.

The Integral Energy cause identification system provides a category for "Unknown" or "No cause found" causes. The total number of unknown causes in 2000/2001 represents approximately 12 % of the total Country Energy SAIDI.

7.3.7 Treatment of Data

In all but certain location in the South, transient incidents such as successful reclose or automatic switching are not recorded. The END system in the South has a specific field to tag transient or sustained interruptions. A few areas do record transient interruptions under this code. Transient incidents are not included when reporting reliability indices.

Generation and transmission related incidents are recorded, but categorised by a specific field code. This allows customer minutes and interruptions due to these faults to be extracted for reliability reporting purposes.

The treatment of repeat interruptions during fault restoration and multiple recloser operations is treated as one operation provided that at least one interruption was a sustained interruption.

Disaggregation of reliability indices by HV feeder, geographic regions (as already defined in reliability database systems), urban/rural (as defined by HV feeder types), underground/overhead faults is possible. Some work may be required to produce the queries that would produce the output reports and the additional mapping required to categorise each HV feeder.

Presently, reliability indices are calculated on a HV feeder basis, these HV feeders are categorised into urban/rural/remote to produce the reliability indices into these categorisations. Similar process can be performed for CBD, urban, short rural, long rural categories once all HV feeders have been categorises as such. Present systems do not allow total customer numbers in each category to be obtained from CIS system in an automated fashion.

7.4 MOMENTARY INTERRUPTIONS AND POWER QUALITY

7.4.1 Power Quality

Country Energy does not presently record and report power quality related indices across their network. They presently have limited monitoring devices across the Country Energy network to begin to perform this task.

Country Energy does have a power quality group whose responsibility is to investigate specific power quality incidents, normally reported by customers. These customer complaints are reported as part of the License Compliance and Network Management reporting.

Country Energy do have a number[40] of "sentry" devices to monitor power quality in specific areas, but it would be prohibitive in both cost, maintenance, and monitoring to rolls these out across the entire network (i.e. on the end of all feeders and spurs) to monitor the network completely.

7.4.2 Momentary interruptions

Country Energy do not presently record and report MAIFI across the Country Energy network.

Most of the main HV feeder circuit breakers at the zone substations will have auto-reclose ability and are linked to the SCADA system. Country Energy presently has about 2650 field auto reclosers. Most of these field reclosers are not linked to the SCADA system, approximately 14 % are of the modern Nulec type, and the majority of an older design requiring field recording of reclose cycles.

Based upon this, the monitoring of the number of successful reclose will require significant field recording.

It is also important to note that the reporting of MAIFI is not a trivial task even if the number of successful reclose actions is known. Some analysis must be performed to remove reclose cycles that occurred prior to a "lock out" resulting in a sustained interruption. If sectionalisers are coordinated with reclosers then some analysis must be performed to assess the number of customers with the momentary interruption and the number associated with the sustained interruption if the sectionaliser opened.

PB Associates considers that the implementation of complete remote recording and information reporting from the 2650 Country Energy field reclosers will require a considerable expense as the existing reclosers are mostly not communications enabled and the installation of communications to remote locations is difficult. If all momentary interruptions are to be recorded this will require significant extra man effort in field reading reclosers, data cleansing, and data entry.

The DAMS and K&M system do not record transient incidents. These incidents could be recorded in these systems if an additional field was incorporated to tag transient faults as such.

7.5 REPORTING OPTIONS

7.5.1 Historical Data

PB Associates considers that the provision of most historical data from Country Energy would be difficult given the recent merger of the Advance Energy, Great Southern Energy and NorthPower regions.

The Country Energy reliability reporting systems are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

PB Associates considers that the Country Energy systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information could be amalgamated and made available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information may also be possible for both planned and unplanned outages.

[40] Country Energy have not been able to provided the exact number of "sentry" devices, although it is thought to be in the order of a few hundred.

The historical Country Energy reliability data is not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates consider that it would not be possible to accurately determine this information from the existing systems.

The present day collection of MAIFI data is not complete. Based on this, PB Associates considers that the provision of historical MAIFI data would be of limited regulatory value.

The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

7.5.2 Energy not Delivered

Energy not delivered is not captured by Country Energy.

It may be possible to estimate energy not delivered for some incident through review of SCADA information. Low voltage and smaller high voltage faults could not be obtained through the present systems and an estimate would have to be made.

Additional fields in the reliability databases would be required to capture this information.

The capture of "energy not delivered" is not presently envisaged within the Country Energy systems.

7.5.3 Faults per Kilometre

Country Energy is currently implementing a scheme based upon categorising feeder by "faults per 100km". This has enable Country Energy to identify the feeders where significant improvements can be made with minimal expense.

7.6 SUMMARY

Country Energy has an active reliability measurement and reporting system that is generally in line with the definitions of the SCNRRR.

The Country Energy reliability measurement systems currently require significant manual input in terms of calculating customer affected and transferring switching times.

PB Associates has identified a number of areas where the current systems and processes will be contributing to reliability data that is not completely representative. The sources of these inconsistencies and their estimated impacts upon the current reliability data are provided in Table 7-1 below.

It is important to note that the estimated impact figures provided below are highly qualitative in nature due to the lack of historical and supporting data. It is also not possible to summate the estimated impact figures as there are interrelations between each factor.

Potential sources of Data Inaccuracy	**Estimated Impact**[41]
LV incidents not presently captured in North[42]	+1.5 % to +3 %
Poor data capture in certain South areas[43]	+3 % to +6 %
Customer numbers affected in North	0 to +10 %
Customer numbers affected in Central[44]	0 to +3 %
Customer numbers affected in South[45]	0 to +6 %
Total Customer numbers including vacant accounts[46]	+6.5 %
Fragmentation of data across regions and sub-regions	0 to +10%
Overall estimate of reliability data Inaccuracy	**+15% to +30%**

Table 7-1

Country Energy has a significant project currently in progress (VOSC/DMS) that encompasses changes to many of the core Country Energy network systems. Part of this project is a proposal to radically improve the processes and systems whereby Country Energy captures reliability performance statistics, automating the calculation of customer numbers affected and restoration times.

The information provided to PB Associates indicates that the project is likely to address many of the items identified in this report. If the project were implemented as described, PB Associates would anticipate a significant improvement to the accuracy of data reported for regulatory purposes. The initial phase of this project involves the consolidation of system operations into one location in the South. This is proposed to result in a single data entry location in Queanbeyan, and a process for reliability capture similar to that used in the North. This should significantly improve the present quality of the reliability data capture in the South region, which for certain depots is poor.

Country Energy reports that the VOSC/DMS project should be complete and in service by 2004. The total cost of the project is approximately $7 - $9 Million. Much of this cost is not directly related reliability data capture and reporting, but is intrinsic in its requirement. For this reason it is impossible to assign a proportion of the cost to that of reliability reporting.

PB Associates would anticipate that the reliability statistics that are presently reported by Country Energy would alter in the future due to the VOSC/DMS project, including the consolidation of operations in the South. Should the historical trend of reliability data capture improvements continue, PB Associates would expect that this would contribute to a worsening in overall reported reliability statistics (SAIDI and SAIFI).

[41] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

[42] Country Energy advise that LV incidents are to be recorded in future reported reliability.

[43] Country Energy advise that this will be improved following consolidation of system operation into on location for South region

[44] Assuming similar scale of error as in North

[45] Assuming similar scale of error as in North

[46] Country Energy advise that vacant accounts will not be included in customer numbers in future reported reliability.

8. AUSTRALIA INLAND ENERGY AND WATER

8.1 OVERVIEW

Australia Inland Energy & Water (AIEW) was formed in 2000 as a result of a merger of Australia Inland Energy and the Broken Hill Water Board. AIEW is the distribution network service provider for Far western NSW. The AIEW network supplies a predominantly rural customer base, having approximately 19,000 customers in total. This is significantly less than other distributors in NSW. The largest centre of population is Broken Hill. The majority of customers are supplied by radial feeders, and there is very little interconnection capability.

A PB Associates representative visited AIEW for a 1 day period, visiting the offices and control room in Broken Hill. The purpose of this visit was to review the reliability reporting processes and interview relevant AIEW staff.

AIEW was unable to supply any answers to the questionnaire prior to the visit by PB Associates.

To give comparison consistency between distributors, the questionnaire was completed by the PB Associates representative, based upon information provided, demonstrations given, and interviews held with AIEW during the visit. This questionnaire was then submitted to AIEW for additional factual clarification and AIEW acceptance. AIEW has been unable to provide a response to the questionnaire.

PB Associates notes the open access that was provided to AIEW staff and documentation during the visit.

Information Systems

AIEW has limited commercial IT systems due to their small customer base size. It presently does not have a SCADA system, GIS system or Asset Management system. AIEW does have a Customer Information System and an Outage Incident database.

Future Information System Works

AIEW has advised that it intends to introduce and upgrade many of their system in the next 12 to 18 months.

AIEW intend to commission a SCADA, Asset Management database system, GIS and new CIS in next 12 to 18 months. This should assist in the ability to link customers to outage incidents and assist in data input.

AIEW are presently unsure how much of its network will be covered by the SCADA system, they would prefer most field reclosers but we would consider it unlikely that this will be feasible.

8.2 POLICIES, SYSTEMS, PROCEDURES AND AUDIT

8.2.1 Network Reliability Reporting

IT Systems

AIEW uses a Microsoft Access database application for outage incident recording. The database was developed in-house around 1997 and is still under development to improve use, although the core application is functioning. Database records are manually input from information taken from hard copy outage sheets within the control rooms. Data is entered at control rooms at Broken Hill, Wentworth and Balranald.

Additional spreadsheet applications are used to generate particular reliability reports.

The input of data into the various databases is highly manual. AIEW could not provide any procedures or formal guidance related to the use of any of the databases.

Human Input

The human involvement in outage incident data collection, database population and reliability reporting is relatively high for both planned and unplanned outages.

For unplanned incidents, a customer call to the call centre initiates requests to the depot to dispatch field staff to locate and repair faults. The field staff are responsible for filing a network outage report (single sheet a4) summarising:

- region,
- customer(s) affected,
- address,
- no. customers. affected,
- outage time, restore time (this may be staged),
- voltage level,
- feeder,
- pole number (note: no AM system to link pole number with HV feeder),
- weather,
- problem (open text box),
- action taken (open text box),
- allocation no. (general asset category for cost allocation – however for fault all fall into fault repair),
- attendant in charge signature, and
- date.

The process for planned incidents is as above and is initiated internally rather than via an initial customer call.

The outage form is used to initiate and populate new records in the supply interruption database. This database has windows type input forms to assist data entry.

Data is entered at depots at Broken Hill, Wentworth and Balraneld. Network outage report forms are normally entered as a batch when time is available (e.g. end of week).

AIEW has not provided details of the training/qualifications for those involved in the fault reporting process.

Weather Related Data

AIEW capture weather conditions for all unplanned incidents.

AIEW defines "severe weather" based upon severe weather days published on the Bureau of Meteorology Website. This is checked prior to reporting and the records relating to these days noted to account for the customer minutes and interruptions during these days.

The present use of the "sever weather" definition is not in line with the SCNNR definition of "excluded events" i.e. exceptional natural or third party events that result in an overall SAIDI impact of 3 minutes.

PB Associates notes that all outages that occur during a nominated severe weather or 3-minute excluded event period are allocated as being excluded events. PB Associates considers it possible that outages may occur in or around this period that were not directly related to the severe weather event. This would be likely to result in a small discounting of the actual company SAIDI, SAIFI and CAIDI figures.

AIEW only encountered 1 severe weather day in 2000/01. This amounted to around 12.6 minutes of SAIDI.

8.2.2 Network Performance Improvements

Reliability Measurement Improvements

The most significant improvement planned by AIEW would be the commissioning of the SCADA system and introduction of a GIS and new CIS. AIEW have advised that this is planned to be in service in 12 – 18 month time. AIEW have not provided forecasts of costs associated with this project.

The SCADA system should allow much improved recording of actual switching times for major HV incidents, and HV faults cleared by the field reclosers linked to the SCADA system. It is assumed these times will be logged in the control rooms rather than the field.

The GIS and new CIS should allow better tracking of customer numbers and their connectivity to the network, depending on whether customer connectivity information is input into GIS and CIS. If this is the case then these systems could be used to calculate customers affected for outage incidents affecting distribution substations and above. Alternatively, the GIS and CIS could be used to assist in routinely updating the schematic in the control room that indicate customer numbers down stream of switching devices. These schematics are presently used to estimate customers affected by faults.

Reliability Improvements

AIEW has provided reports indicating that AIEW are assessing areas with poor reliability. The cause for this poor reliability is ascertained, and remedies are devised. AIEW also track the progress of the reliability projects in terms of reliability of the areas that have been noted for poor reliability.

This information is summarised in the AIEW Electricity Network Management Report.

8.2.3 Audit Reports

PB Associates was provided with copies of an independent appraisal of the License Compliance and Network Management Report for AIEW. These Appraisal reports are relatively short document and deal with all issues with respect to License compliance reporting, including reliability reporting.

The following is the salient extracts in the appraisal report:

Reliability and Completeness of Reports – "*The reliability and integrity of the data and reports has been assessed for each of the license conditions in accordance with the guidelines…..All license conditions have been assessed as grade A*"

The details of this appraisal, specifically with respect to reliability reporting, have not been provided by AIEW.

8.3 DATA RELATING TO CUSTOMER INTERRUPTIONS AND DURATION

8.3.1 Customer numbers

AIEW counts total "customers" based upon counts of active customer services within their CIS systems. Each service has a NMI associated with it. AIEW have stated that unmetered supplies such as Traffic Lights/Telephone Boxes/bus shelters/Streetlights are not included in customer numbers.

At this stage there is no link between the customer details in the CIS and the new feeder categories, CBD, Urban, Rural Short and Rural Long. As such there is no easy method of counting total customer numbers for the feeder categories in the CIS. The present system of counting total customers is based upon tariff type. AIEW are planning to commission a new CIS and GIS system. This should allow the total number of customers associated with a feeder type to be estimated using an algorithm in the GIS system provide all customers are tagged to a feeder (possibly via distribution substation tag) and feeders have been categorised appropriately. Prior to this a manual and approximate process may be required to categorise customers to the SCNRRR categories.

8.3.2 Measuring number of customers affected

The AIEW method for estimating customer numbers affected is manual.

For LV incidents, the field crew estimate the number of customers affected based upon their knowledge of the fault and the customer base in that area. It should be noted that for rural areas, and urban areas of the customer density of Broken Hill this should result in a reasonably accurate estimate of customer numbers affected.

For HV and above incidents, customer numbers affected are calculated from hard copy schematics that have total customer numbers recorded down stream of main isolation points and distribution substations. For particular spurs not detailed on the schematics, a Protection Summary Report hard copy document details individual customers by name down stream of particular protection devices on the spurs.

AIEW advised that customer numbers on schematics are updated annually. It is impossible without performing a far more comprehensive audit to gauge the scale of inaccuracy in the affected customer counting applied in the AIEW. It would be expected that due to low growth rates in the region, inaccuracies due to historical customer number counts would not be appreciable.

Adjustments to affected customer numbers

Where a staged restoration has occurred and these stages have been recorded on the log sheet, the calculation of the number of customer affected for each stage is calculated as described in the section above.

It is important to note that due to the limited interconnection ability in the AIEW network, staged restorations are not common.

Single Customer Outages

Single customer outages are recorded provided they are due to a AIEW network fault.

System Abnormalities

AIEW advise that system abnormalities (e.g. load transfers and switching) are taken into account when estimating customer number affected using the same methods as described above.

As this system relies on the operator to check for abnormalities and manually estimate customer numbers there is opportunity for errors to occur, however it is not possible to quantify these potential errors. AIEW have advised that due to the limited interconnection ability in the network there are very few occasions when this occurs. PB Associates would agree with this and consider that any potential inaccuracy would be immaterial.

8.3.3 Classification of Feeders

AIEW are intending to use the feeder classifications as defined in the SCNRRR report.

Route lengths will be taken manually from construction diagrams. It is important to note that AIEW do not have a large number of feeders, and therefore, the manual calculation of feeder lengths from construction diagrams is not an unrealistic task.

8.3.4 Restoration Times

For fault incidents, the initial interruption time is recorded as the time of the first customer fault call to the Call Centre. The initial interruption time and subsequent switching times are recorded on the "Network outage – trouble report" hard copy form that is used as the base input for the reliability database record. This switching time information is recorded by the fault attendee. A similar process using the same form is used for planned incidents.

Actual switching times are recorded. It would be expected that since the switching times are recorded by the fault attendees that the switching times would be filled in at a later time than the actual switching occurred, and therefore, an approximate switching time may sometimes be used (e.g. rounding to the nearest 5 or 10 minute interval).

It would be expected that following the commissioning of a SCADA system for the AIEW network, the actual time of switching for major HV faults would be transferred manually directly from the SCADA system. This may well be via a control room hard copy switching sheet.

8.3.5 Handling of Staged Restorations

The timing of intermediate stages of restoration are recorded as described in the above section.

It is important to note that due to the limited interconnection ability in the AIEW network, staged restorations are not common.

8.3.6 Incident Causes

AIEW provided PB Associates with detailed information relating to the classification of incident causes in its reliability database system. The following summarises these classifications:

Cause Description	**Group**
Equip - Failure or Defect	Equipment
Loss of Cross border supply	Incoming Supply Failed
Equip - Inadequate Design/Overload	Equipment
Loss of Transgrid supply	Incoming Supply Failed
Equip - Inadequate Maintenance	Equipment

Cause Description	Group
Lightning or Electrical Storms	Weather
Major Lightining or Electrical Storm	Weather
Wind (Wind debris)	Weather
Flood or Cyclone	Weather
Snow, Sleet or Blizzard	Weather
Trees blown onto Mains	Weather
No cause found (storm)	Weather
No cause Found	Weather
Trees Growing into Mains	Environment
Animals and Birds	Environment
Corrosion	Environment
Pollution	Environment
Fire - excluding Pole Top	Environment
Vandalism	Human
Accidental (Vehicle, Plant, etc)	Human
Customer Installation	Human
Operator or Staff Error	Human
Industrial Relations	Human
Safety Reasons	General
Overload	General
Due to Gen & Trans System	General
Load Shedding	General
No cause found (No Storm)	General
Other	General
Planned Outages	Planned
Planned Outages - Customer Request	Planned

Weather Description
Fine

Weather Description
Hot and windy
Cold and windy
Severe winds
Light rain-no wind
Light rain-wind
Heavy rain-no lightning
Heavy rain and wind
Stormy and lightning
Cold and frost
Unknown
Cold
Hot and still
Foggy

AIEW advised that there is no formal written guidance on the use of the "cause" categories. AIEW considered the technical competence of the AIEW personnel responsible for cause identification and logging is sufficient for accurate reporting. The cause as defined in the database is not recorded on the "network outage – trouble report sheet" by the fault attendee. The cause and equipment involved are recorded in open text fields on the outage report form. The data entry personnel select the appropriate cause category based upon these descriptions on the form.

Within the database there is also two text fields to record a brief description of both the incident (problem) and the action taken as defined on the "network outage – trouble report" form.

The AIEW database records primary cause only, although other information can be input into problem and action text field. Faults due to equipment failure are defined as an explicit cause, however, the equipment type and nature of the failure (e.g. age and wear, poor design, etc) are not recorded other than in the open text field (i.e. simple filtering on equipment types is not possible). The weather at the time of the incident is defined as a separate field from the cause, although weather is also related to the cause definitions.

The AIEW cause identification system provides a "No cause found" category. In 2000/01, the "no cause found" associated customer minutes = 279,472 out of total of 3,031,355 unplanned customer minutes which equates to 9.2% of unplanned SAIDI.

8.3.7 Treatment of Data

AIEW advise that all incidents only involving unmetered services or non-consumer involved incidents would not have customer numbers associated and would therefore not be input into database. Customer requested interruptions are not input into database.

Generation and transmission related incidents are recorded, but categorised by a specific field code in the cause category. AIEW customer interruptions due to outage incidents on the Powercor feeders supplying certain customers in the South of the AIEW region are also categorised as generation and transmission related incidents. This allows customer minutes and interruptions due to these types of incidents to be extracted for reliability reporting purposes.

The treatment of repeated interruptions during fault restoration and multiple recloser operations is treated as one operation provided that at least one interruption was a sustained interruption.

Disaggregation of reliability indices by HV feeder, geographic regions (as already defined in reliability database systems), urban/rural (as defined by customer type), underground/overhead faults is possible.

Presently SAIDI, SAIFI etc. can not be put into CBD, Urban, short rural, long rural categories easily, although when all HV feeders defined into these categories, it should be possible to sum customer minutes in each category. The calculation of total customer number for each category may be a manual and approximate exercise as customers are not defined to an HV feeder in the existing CIS.

8.4 MOMENTARY INTERRUPTIONS AND POWER QUALITY

8.4.1 Power Quality

AIEW do not presently record and report power quality related indices across their entire network. They have some monitoring devices across the AIEW network to begin to perform this task.

AIEW do report Power Quality complaint investigations in their Electricity Network management report.

AIEW do have a number of "sentry" devices to monitor power quality in specific areas, but it would be prohibitive in both cost, maintenance, and monitoring to rolls these out across the entire network (i.e. on the end of all feeders and spurs) to monitor the network completely.

8.4.2 Momentary interruptions

AIEW do not presently record and report MAIFI.

As AIEW have no SCADA systems, they have limited ability to remotely record auto-reclose actions.

Based upon this the monitoring of the number of successful reclose will require significant field recording.

It is also important to note that the reporting of MAIFI is not a trivial task even if the number of successful reclose actions is known. Some analysis must be performed to remove reclose cycles that occurred prior to a "lock out" resulting in a sustained interruption. If sectionalisers are coordinated with reclosers then some analysis must be performed to assess the number of customers with the momentary interruption and the number associated with the sustained interruption if the sectionaliser opened.

The planned implementation of a SCADA system in AIEW should improve the monitoring of successful reclose for reclosers linked to the SCADA, but PB Associates considers that the implementation of complete remote recording and information reporting from all AIEW field reclosers may require a considerable expense, as the present reclosers will not be communications enabled and the installation of communications to remote locations may be difficult.

The reliability database will require slight modification to tag momentary interruptions. As the database is developed in Microsoft Access this should not be difficult. If all momentary interruptions are to be recorded this will require significant extra man effort in field reading reclosers, data cleansing, and data entry.

8.5 REPORTING OPTIONS

8.5.1 Historical Data

The AIEW reliability reporting systems are not presently aligned with the SCNRRR requirements. This means that the historical reliability information is also not aligned with SCNRRR.

PB Associates considers that the AIEW systems are able to provide limited historical reliability information of reasonable accuracy for the previous three years. System wide SAIDI, SAIFI and CAIDI information is available and consistent with present-day information. The SAIDI, SAIFI and CAIDI information should also be available for both planned and unplanned outages.

The historical AIEW reliability data is not available on a feeder category basis (e.g. CBD, urban, short rural and long rural) and PB Associates consider that it would not be possible to accurately determine this information from the existing systems.

The present day collection of MAIFI data is not complete. Based on this, PB Associates considers that the provision of historical MAIFI data would be of limited regulatory value.

The availability of quality of supply information relating to customer complaints and the actions taken is reasonably complete, although the format is not precisely aligned with the SCNRRR framework. PB Associates considers that the provision of historical quality of supply information is possible, but would require manual review and collation to match SCNRRR requirements, particularly to match the cause categorisation.

8.5.2 Energy not Delivered

Energy not delivered is not captured by AIEW.

With the present systems, it would be difficult for AIEW to estimate energy not delivered. A simple method would be to assign an average power taken by each customer, or group of customers, and detail this on the schematics and protection report in a similar way to customer numbers. This number could be input along with customer numbers affected. This would require additional man effort by AIEW personnel to produce these values and routinely update them.

Additional fields in the reliability databases would be required to capture this information.

8.5.3 Faults per Kilometre

AIEW do not report faults per km. AIEW do have the information to report this at the system level if required (i.e. a total faults per km). Following the work required to calculate route lengths for feeder categorisation into the SCNRRR categories, AIEW would be in a position to report fault per km in the SCNRRR categories if required.

8.6 SUMMARY

AIEW has a reliability measurement and reporting system that is generally in line with the definitions of the SCNRRR, although further work is required to categorise feeders. The AIEW reliability measurement systems currently require significant manual input in terms of calculating customer affected and recording and transferring switching times.

PB Associates has identified a number of areas where the current systems and processes may be contributing to reliability data that is not completely representative.

The sources of these inconsistencies and their estimated impacts upon the current reliability data are provided in Table 8-1 below.

It is important to note that the estimated impact figures provided below are highly qualitative in nature due to the lack of historical and supporting data. It is also not possible to summate the estimated impact figures as there are interrelations between each factor.

Potential sources of Data Inaccuracy	**Estimated Impact**[47]
Customer number affected based upon historical customer counts.	-3% to +5%
Restoration times based upon estimate.	-5% to +5%
Error in process of customer number counts for updating schematics in control rooms.	-5% to +5%
Errors in data input.	-3% to +5%
Overall estimate of reliability data Inaccuracy	**-10% to +15%**

Table 8-1

AIEW presently do not have a SCADA system, asset management system or GIS. AIEW are proposing to install such systems in the next 12-18 months. These systems should improve the accurate capture of HV switching times, and assist in the categorisation of feeders and associated customer counts.

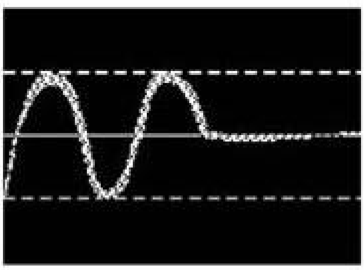
AIEW has not provided any estimates of project schedules or costs.

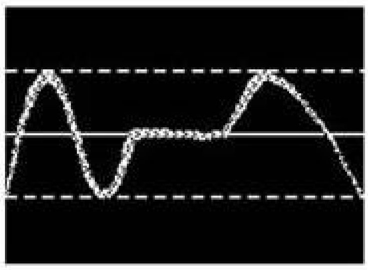
[47] Estimated impact applies only to SAIDI, SAIFI and CAIDI reporting only. A positive figure represents the potential for actual reliability data to be higher than that presently reported, while a negative figure represent the potential over reporting.

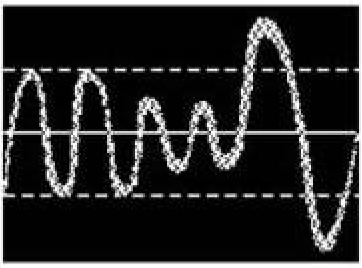
APPENDIX A
Definitions

DEFINITIONS

Term	Definition
ACCC	Australian Competition and Consumer Commission. The Federal body charged with monitoring competition throughout Australia.
Billing	The process of generating bills for customers. For networks, billing generates invoices for retailers. For retailers, billing generates Electricity or Gas bills for end users (the public).
Byte	The basic storage unit in computers. One character is stored as one byte. Most numbers are stored as four bytes.
Call Centre	A facility operated by participants for answering of telephone queries from customers. Participants needs to make enhancements to their Call Centre to support FRC and are they entitled to recovery those incremental costs. A staffed location, which answers calls from customers or prospective customers.
CAPEX	Capital Expenditure. The template PB Associates provided to participants, asked them to capture Capital Expenditure as Hardware, Software and/or Labour.
CIS	A generic name given to the IT&T systems that provide the services and capabilities required to manage customers, Typically these systems contain a database of an organisations customers and a history of all the interactions and transactions carried out by the customer. They are utilised by: 1) front office staff, typically Call Centre personnel to handle customer calls in the most efficient manner possible. 2) 2) back office staffing to support business processes such as billing, and service orders. They are also commonly referred to as a Customer Care System (CCS), and Customer Support System (CSS). The Customer Information System is typically the central system for any large Energy business.
Customer	Under FRC, for a retailer, customers are consumers (members of the public). For distributors, customers are retailers.
Distribution Business	A licensed corporate entity authorised to deliver Electricity to retailers and customers.
Distributor	A licensed corporate entity authorised to deliver Electricity to retailers and customers.
DNSP	Distributor Network Service Provider. See Distributor.
Fault	Unexpected and unwanted event on item(s) of network equipment. This may result in the automatic or manual operation of certain switching actions to protect the network or personnel. This switching will generally result in an Outage.

Term	Definition
FRC	Full Retail Contestability. A change in market conditions where small Electricity and/or Gas consumers can select which Retailer they can purchase energy from. FRC is being introduced to NSW and Victoria in both the Gas and Electricity markets.
FTE	Full Time Equivalent. A unit of labour, equivalent of one person working fulltime. For example, three part-time workers may equal one FTE.
GMCo	Gas Market Company. The corporate entity responsible for administering retail market arrangement including incentive payments by participants. GMCo is owned by the NSW Gas Market participants, but under the terms of a deed has substantial accountability to the NSW government.
Inactive account	An inactive account is defined as an existing supply point that is presently not energised or temporarily disconnected. Examples of inactive accounts are vacant homes and offices.
Incident	An outage either planned or as a result of a fault which results in Interruption of supply to customer.
Interruption 	A total loss of power to a customer or group of customers. Interruptions/outages are classified as longer than one minute. **Cause:** Sometimes planned, but most commonly unplanned. Unplanned outages are often a result of equipment failure, accidental digging of power lines during construction or landscaping, lightning strikes or storms, animals (birds, squirrels, etc.) on power lines, tree limbs growing into power lines and car accidents. **Impact:** prolonged loss of supply.
IPART	See "Tribunal, the"
IT	Information Technology
Jurisdiction	A political boundary, in which specific rules and regulations operate. NSW and Victoria are two examples of two separate jurisdictions.
MDA	Metering Data Agent. A licensed corporate entity within the NEM, who collects and processes meter read data.
Meter	A device that measure consumption of Gas or Electricity over a period of time. There are two different types of meters:- **Basic Meter:** An inexpensive Electricity or Gas meter typically used in households that measures the total energy use over a long period-of-time (typically weeks or months). **Smart Meter:** Larger consumers of energy, typically have meter capable of measuring and storing consumption measurements over thirty minutes or one-day intervals. Smart Meters are also known as TOU (Time Of Use) and Interval Meters.

Term	Definition
Metering	A system for processing meter reads. In most cases, participants implement two metering systems (one for manual meters, one for smart meters). The Metering system is normally responsible for "profiling" as well and keeping historical information on meter reads for regulatory and marketing purposes.
MEU	Ministry of Energy and Utilities of the NSW Government.
MIG	Market Implementation Group
Momentary Interruption 	Planned or unplanned outages that last less than 1 minute. **Cause:** Usually due to operation of system equipment to clear faults, or reflections of faults on other parts of the network. **Impact:** Especially for critical loads, can cause equipment (e.g. computers and digital equipment) to go off-line, loss of programming, etc.
NEC	National Electricity Code.
NEM	The National Electricity Market, operated by NEMMCO on behalf of the NSW and Victoria jurisdictions; amongst others.
NEMMCO	National Electricity Market Management Company. The entity responsible for settling financial transaction in the National Electricity Market that currently operates in NSW, ACT SA, QLD & Victoria
Network Operator	See Distributor
NMI	Network Metering Identifier. A unique number that identifies contestable Electricity supply points and typically the end-user metering point.
OPEX	Operating Expenditure. The template PB Associates provided to participants, asked them to capture Operating Expenditure as Hardware, Software and/or Labour.
Outage	The isolation of network equipment or group of equipment, usually by opening of network switching devices. This results in de-energisation of outaged equipment, and hence, an Interruption of supply to customer connected to this equipment. Depending on redundancy in the network, outages of certain items of equipment or sections of the network may not result in Interruptions to customers.
Power Quality	Refers to the provision of electrical supply within accepted standards. Typical examples of power quality concerns include momentary outages, voltage sags and swells, imbalance between phases, and harmonics within the wave form.
Retailer	A licensed corporate entity authorised to sell Gas and/or Electricity to end-users. (i.e. the public)

Term	Definition
Sags/Swells 	Brief reductions or increases in voltage that last up to 15 seconds. **Cause:** Major equipment start-up or shutdown, short circuits on the system or under-sized electrical circuits. **Impact:** Memory loss/data errors, dim or brightening of lights and equipment shutdowns.
SCNRRR	Steering Committee On National Regulatory Reporting Requirements
Tribunal, the	IPART is an independent body that oversees regulation in the Water, Gas, Electricity and Public Transport industries within New South Wales.
UMS	Unmetered Supply. A supply point with a standard or known, typically small, usage where it is standard practice to not utilise a meter to record consumption. Examples include council and highway street lighting, bus shelters, phone boxes, traffic lights and utility security lighting.